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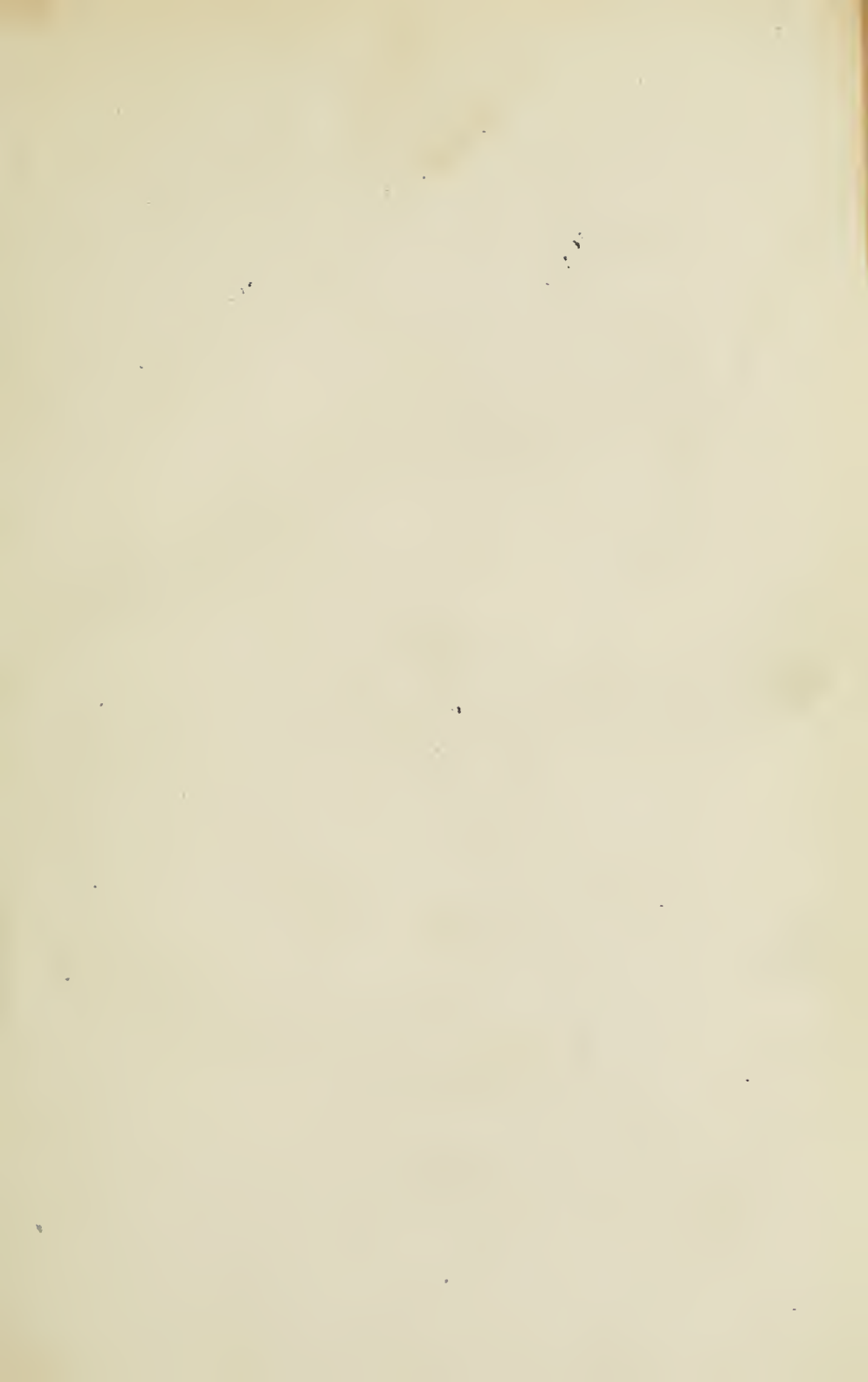
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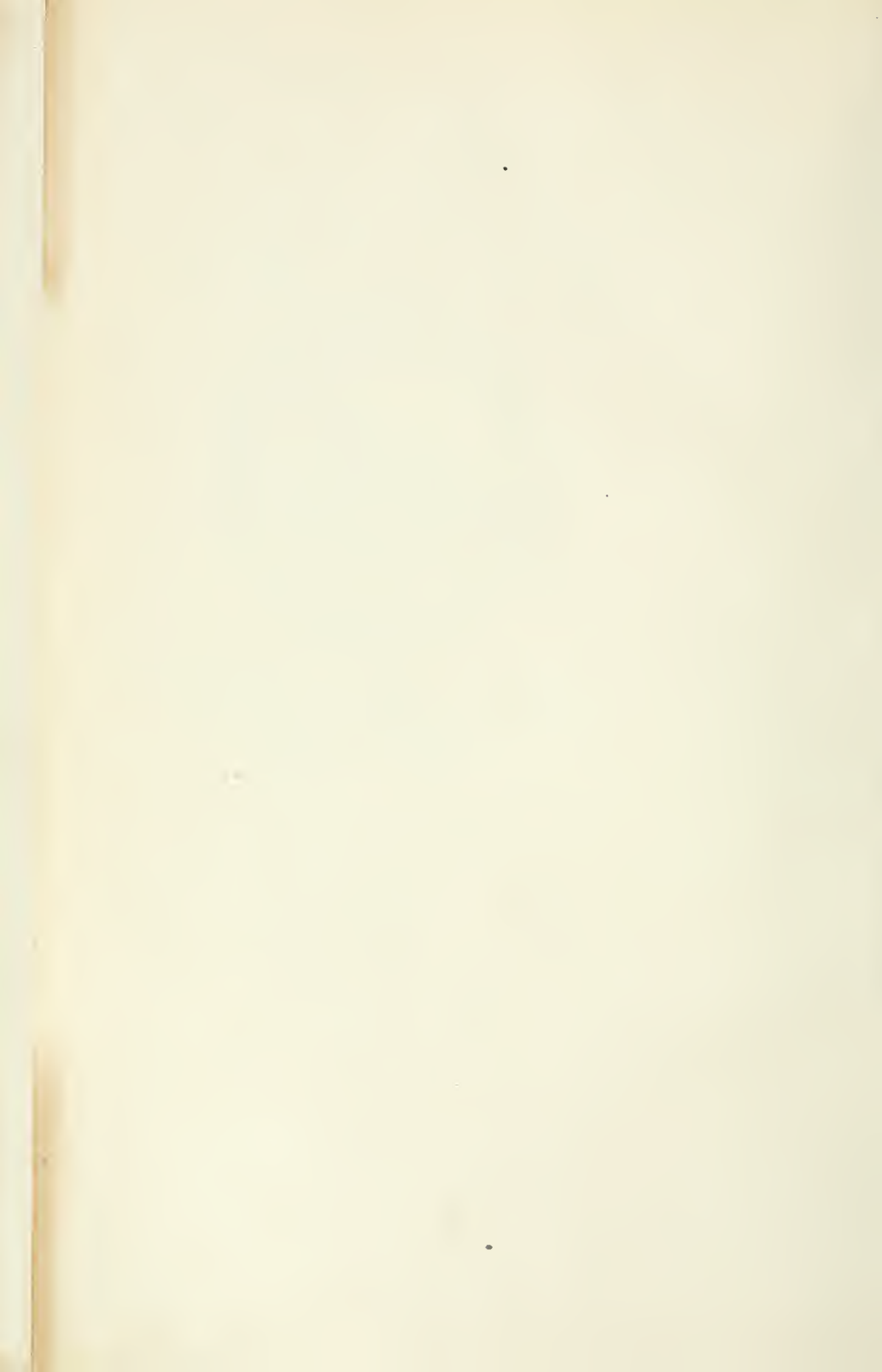


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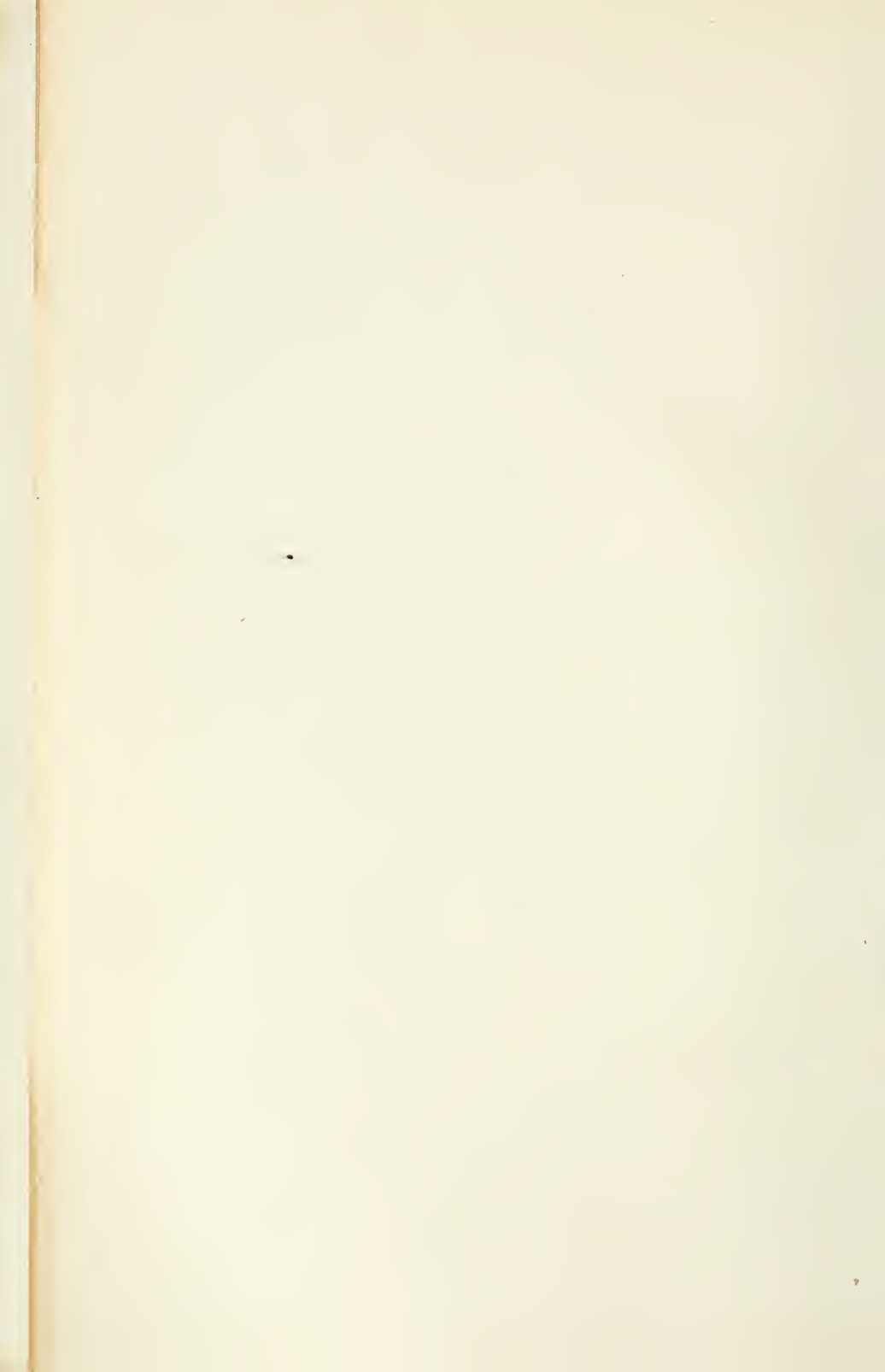
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ARCHIVES

OF

OTOLOGY

EDITED IN ENGLISH AND GERMAN

BY

DR. H. KNAPP

OF NEW YORK

PROF. S. MOOS, M. D.

OF HEIDELBERG

AND

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OF NEW YORK

IN CONJUNCTION WITH

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# ARCHIVES OF OTOTOLOGY.

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## NERVE ATROPHY IN THE FIRST COCHLEAR CONVOLUTION: ITS PHYSIOLOGICAL AND PATHOLOGICAL IMPORTANCE.

BY S. MOOS AND H. STEINBRÜGGE, OF HEIDELBERG.\*

Translated by I. FURST, of New York.

(With lithographic Plate i.)

FOR the opportunity to study and examine the following case, and for its history, we are indebted to Prof. Erb, in whose wards the patient was placed, and who has published and detailed, in the *Deut. Arch. f. klin. Med.*, Bd. xiii, H. 1 and 2, pp. 172 *et seq.*, this, also in a neuropathological sense, exceedingly interesting case.

Anton Gref, æt. 63, a mason from Friedrichsfeld, was admitted October 26, 1878, to the electro-therapeutic ward of Prof. Erb.

Patient had observed the commencement of his trouble some two weeks before. He awoke at night about three o'clock, when his left arm was tossed in various directions by convulsive movements. There were tonic and clonic spasms in the left arm.

After the spasms ceased, great weakness remained in the arm; motion was possible only after some time. These attacks have recurred six times until the present; no new phenomena have been developed. Right arm healthy. The left leg appears to patient to be a little weaker. No headache, only now and then some vertigo. Consciousness unimpaired during the attacks. Mastication, deglutition and articulation good.

*Status præsens.*—A tall, vigorous, for his age comparatively well-looking man. Inspection at once reveals that the left hand is red,

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\* Paper read September 6, 1880, by S. Moos before the Second International Otological Congress, at Milan.

the fingers being rather glossy and slightly œdematous. The arm depends nearly immovably from the shoulder joint.

Walking and standing good. Legs rather muscular, motor power not sensibly diminished. No disturbances of sensibility.

Patellar tendon reflexes very strong on both sides. Left side, distinct dorsal clonus; right, slightly indicated; bilaterally, reflex of adductors. Plantar reflex on the left very distinct; on the right, weak. Cremaster and abdominal reflexes distinct on both sides.

Triceps tendon reflex in both arms, and reflex in the biceps muscles on tapping the carpal extremity of the radius.

Nothing of importance in the right arm. Slight emaciation of the left arm. Muscles and nerves respond to faradic and galvanic irritation. No degenerative reaction.

*Oct. 4th.*—Patient has again had tremors in the left arm and in the left leg as well. Some vertigo for two days past.

*Oct. 9th.*—Another attack of tremors during the night. Arm is again weaker. Tremors are also noticeable in the left leg, with succeeding weakness. Paresis of the muscles of the thigh particularly.

*Oct. 18th.*—Vision, motions of eye, mimic motions, mobility and position of tongue normal. Sensibility of face normal, uvula straight. Soft palate, during phonation, perhaps moved a little better on the left than on the right side. Left upper extremity almost completely paralyzed; slight motions may be excited in the biceps, brachialis internus and pectoralis major. Sensibility perfectly normal. Tendon reflexes more vivid on the left than on the right side.

*Oct. 19th.*—Left leg decidedly paretic, gait dragging and rather scraping; standing on the left leg is difficult; no staggering on closing the eyes. No ataxia. Sensibility quite normal. Mechanical irritability of the muscles greater than on the right; tendon reflexes increased in both legs, but more so on the left than on the right. Urinary and alvine evacuations normal. Spine and formation of skull normal. Rapping on the head is not painful.

*Oct. 21st.*—Patient had four attacks yesterday. Ice-bladder to the head. Laxative water.

*Oct. 22d.*—Potassium bromide, eight grammes; potassium iodide, four grammes.

*Oct. 26th.*—Urine normal in color and quantity; sp. gr. 1.009; free from albumen or sugar.



*Oct. 31st.*—Had six attacks since yesterday, each lasting about eight minutes. *Sensation of vertigo* and *headache*; the latter chiefly located in the right frontal region. Temperature in the right axilla, immediately after an attack,  $36.6^{\circ}$ ; left,  $37^{\circ}$ . Pulse, after an attack, 80.

*Nov. 2d.*—Two attacks yesterday. Temperature since yesterday morning *continuously lower* in the right axilla than in the left, while hitherto the difference existed only after an attack.

*From Nov. 3d to Nov. 25th.* From one to four attacks every two to four days; after that date, until death, only a few slight attacks.

*Nov. 25th.*—Twitching of muscles of face. Left lower extremity almost completely paralyzed.

*Dec. 10th.*—Ophthalmoscopic examination by Dr. Kuhnt. Dilatation of veins and slight œdema of optic disc in the left eye; no œdema in right eye. Progressive paralysis of deglutition.

*Dec. 21st.*—Slight double neuritis, more pronounced in left eye. Incontinence of urine.

*Dec. 31st.*—*Exitus letalis.*

*Clinical diagnosis.*—Hemiparesis lateralis sinistra from a cortical affection of the right central convolution.

*Autopsy.*—Carcinoma of the right anterior central convolution. Carcinoma of the stomach.

The *examination of the organ of hearing* was made two weeks before death. Following is the result:

Adam Gref, æt. 63, mason. Sick since 1870. Suffers from impaired hearing, particularly on the right side, and from continuous tinnitus. The ear affection is said to have occurred suddenly. Membrana tympani unaltered on both sides. Hearing distance for speech—right = 0; left = 3 metres.

With Politzer's acoumeter—right = 0.01 metre; left = 0.02 metre.

Bone-conduction for the watch from the temple—right = 0; left, weak.

Tuning-forks from the forehead:

a'*	is perceived		
c'	"	"	right.
c	"	"	"

Tuning-forks by air-conduction:

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\* C = 66 vibrations per second; c = 132; c' = 264; A = 110; a = 220; a' = 440.—K.

Right.	Left.
$a' = 0,$	$a' =$ barely heard,
$c' = 0,$	$c' = 0.05$ metre,
$c = 0.01$ metre.	$c = 0.01$ “

*Post-mortem Appearance of the Right Petrous Bone.*

Erosions and dehiscences on the base of the pyramid to an extent of  $2\frac{1}{2}$  cm. in the direction of the longitudinal axis, and of 2 cm. in the direction of its transverse axis. The roof of the glenoid fossa is thinned so as to appear translucent. The longitudinal diameter of this oval erosion corresponds to that of the articular cavity and measures 0.01 cm., while its transverse diameter measures 0.007 cm. The greatest number of the before-mentioned dehiscences is above the mastoid antrum.

Air blown through the tube by a catheter causes a slight blowing noise on auscultation, no rattling. The mucous membrane of the tympanic cavity and of the ossicles is normal. The malleo-incudal and incudo-stapedial joints are movable. Stapes with difficulty movable in the fenestra ovalis. Membrana tympani and manubrium mallei normal. The mastoid process seems to be in a state of sclerotic thickening, with diminution of the collective capacity of the cellular spaces it contains. The sclerosed bone measures from the outside to the centre of the posterior border of the sigmoid fossa, 0.02; from the posterior wall of the auditory meatus to the mastoid antrum, 0.005; from the base of the styloid process to the commencement of the cellular spaces, 0.011 cm.

*Microscopic Appearance of the Right Labyrinth.*

Method of examination: Comp. these ARCHIVES, vol. ix, pp. 113 *et seq.*

*Condition of the central termination of the acoustic nerve and its trunk in the porus acusticus internus, and of the internal auditory artery.* The greater part of the nerve-fibres was normal; atrophic ones were only exceptionally found. The atrophy was characterized by the loss of the medullary sheath, so that only the axis-cylinder was preserved; besides, granulated cells were encountered here and there. The ganglion-cells of the nervus vestibuli were in part very small.

The branches of the internal auditory artery, as far as the canal of Rosenthal, were to a great extent in atheromatous degeneration. Their walls showed spots of fusiform thickenings, and their sheaths contained multiple smaller and larger, variously shaped but mostly rounded concretions\* of phosphate of lime.

The nerve-fibres of the lamina spiralis ossea of the second and third cochlear convolutions exhibited a normal appearance and their number did not seem to be diminished. Perhaps there were fewer transverse anastomoses. The nerve-fibres of the *first convolution* of the lamina spiralis ossea, however, showed remarkable alterations (comp. figs. 2, 4 and 6). In *surface preparations*, the single bundles of nerve-fibres, immediately after passing through the modiolus and in their course to the lamina spiralis membranacea, appeared narrower and more transparent than under normal conditions. The transverse anastomoses were less numerous, and the network formed by them had larger meshes than normally.

*Vertical sections* through the lamina spiralis ossea of the *first convolution* displayed, instead of the broad bundles of nerves present in the normal state, only extremely sparse, isolated, radiating nerve-fibres. The latter were interrupted in some places by small lacunæ which, in their turn, were filled in part by transverse sections of spiral fibres (comp. fig. 4). *Therefore the case was one of quantitative atrophy of the nerve-fibres in the lamina spiralis ossea of the first cochlear convolution.*

The condition just described was still further elucidated by examination with Hartnack's immersion objective No. 9 and eye-piece No. 3. Under this magnifying power, too, we found an evident disappearance of nerve-fibres; while the remaining ones were represented solely by detritus or fractional portions of some single and some aggregated radial or spiral, abruptly terminating fibres. This sudden break in the single fibres conveyed the impression that they

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\* Such were also found in the sheath of the cochlear nerve, and in the wall of a vessel of the connective-tissue layer in the superior semicircular canal; this layer, moreover, was thickened. The length of one of the larger concretions was 0.084 mm., its width, 0.017—0.023 mm.

were torn off, but the condition could by no means have been artificial: first, because the lamina spiralis ossea was detached, with the greatest care, immediately at the modiolus, and especially, secondly, because the processes \* situated on its upper plate were preserved intact.

Aside from the alterations just described, these remnants of nerve-fibres showed distinct *varicosities* alternately with deep indentations. Withal, the double outline was preserved throughout, and the varicosity was particularly caused by fusiform and club-shaped swellings of the axis-cylinders. Besides, in some places, the nuclei of Schwann's sheath were enlarged, and a few of the varicose-hypertrophied nerve-fibres contained, in addition, a roundish or irregularly shaped, sometimes brighter, sometimes darker corpuscle.

Some varicose nerve-fibres were also found in the *canal of Rosenthal*. The number of the at times nucleated, at times non-nucleated ganglion-cells found there was exceedingly small. The contents of the non-nucleated cells were homogeneous. The nuclei were only exceptionally stained in carmine solution, and the cell-contents, where they were homogeneous, took either a faint coloration or remained colorless.

*Condition of the hair cells.*—After an immersion of vertical sections of the first cochlear convolution in a carmine solution during twenty-one hours, the hair cells remained uncolored. Otherwise, only the external ones displayed a normal appearance. In the place of the inner ones, there was a finely-granular, molecular, colorless mass. In the second cochlear convolution, a great part of the hair cells appeared perfectly normal; some had no nucleus and made the impression of large, oval, granulated cells. No pathological changes were found in the third cochlear convolution.

Regarding the lamina basilaris membranacea, a uniform dilatation of the perivascular lymph-sheaths should be mentioned (see fig. 6). While in various normal preparations

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\* For these compare the illustration furnished by Waldeyer, fig. 325, in Stricker's "Gewebelehre," Bd. ii, p. 928. On intact preparations, as is well known, they may be seen by focussing high, while the nerve-fibres situated underneath become distinctly visible by focussing low.



of the lamina spiralis membranacea we found the diameter of the perivascular lymph-spaces on each side of the vessel as large as the diameter of the blood-vessel itself, in our case it was two, three to five times as wide. This dilatation was uniform throughout, with the exception of a single partially dilated lymph-space within the lamina spiralis ossea (first cochlear convolution, near the modiolus).

*Condition of the membranous parts of the vestibule and its annexes:*

The cells of the ligamenta labyrinthi\* were partly normal, partly non-nucleated, with homogeneous contents, which were but faintly stained by carmine. The membrana propria was not materially changed. The epithelial layer of the semicircular canals, which was normal in some places, showed in others fatty and colloid degeneration, with a great number of granulated cells.

Similar alterations were found in the epithelial cells of the utriculus. The most striking changes were in the epithelial layer of the ampulla of the horizontal semicircular canal. The specimen in question, which, after prolonged immersion in carmine solution, had assumed only an extremely faint coloration, exhibited a great variety in the form and size of its epithelial nuclei. Many were no longer homogeneous but granulated; where the round form was still preserved, they only represented empty rings of rows of granules, arranged like strings of beads. The cell-wall frequently showed the same condition. The cell-contents were either homogeneous, or likewise granulated and colorless.

The nerve terminations in the utriculus and ampullæ showed nothing abnormal. The preparations of the sacculus unfortunately did not succeed sufficiently well to permit us to form a positive opinion of the conditions.

*Remarks.*—The main results of the above-described alterations may be summed up in the following:

The external ear, membrana tympani, and the apparatus of the tympanic cavity were normal, with the exception of the stapedio-vestibular joint. The sclerosis of the cells of

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\*Comp. these ARCHIVES, vol. ix, p. 116.

the mastoid process probably does not enter into the consideration of the disturbances in the auditory function. Of greater importance is the defective mobility of the stapes in the fenestra ovalis. This condition, as the sole anatomical condition in morbid processes in the tympanic cavity, has been observed, though rarely, also by other investigators, for instance, Schwartze, and in our case has probably developed gradually in the course of some years. It may be looked upon as one of the causes of the impaired hearing and of the subjective auditory perceptions; at all events, it implied an increase of the intralabyrinthine pressure. Inasmuch as the patient stated that his affection commenced suddenly, the possibility cannot be excluded that, aside from the above-described alteration in the stapedio-vestibular joint, an exudation into the labyrinth may have taken place at the onset of the disease.

However, an assumption of that kind for the explanation of the atrophy in the first cochlear convolution is not absolutely necessary. With the increased intra-aural pressure which had been present for years, and which, possibly, in the last few months of life had become still higher by the development of a cerebral new-formation,\* we may, on the one hand, imagine a simple atrophy by inactivity; while, on the other hand, the atheromatous alterations found in the branches of the internal auditory artery, or, finally, a lymph-stasis, caused by increased pressure, may serve to explain the above-described nerve atrophy.

In our case, if we speak of an atrophy by inactivity of the nerve-fibres in the first cochlear convolution, we have pre-eminently in view the important fact found by C. Burnett under the direction of Helmholtz, that *under artificially increased labyrinthine pressure*, the vibrations, transmitted by means of the sound-conducting apparatus to the labyrinthine fluid, were *weaker in the transmission of high tones* than when low tones were made to act on the membrana tympani. Burnett demonstrated this decrease of the vibrations during the experiments with high tones, by observing the oscillations of the membrane of the fenestra rotunda,

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\*Otherwise the neoplasm has no connection with the impairment of hearing.

and found even a complete cessation of these as soon as the intralabyrinthine pressure was still further increased.

In applying the result of these investigations to the case under consideration, we see that, in consequence of the increased intra-aural pressure, the labyrinthine fluid was no longer set in motion by the high tones, and the strings of the zona pectinata in the lower convolution, therefore, were no longer brought into sympathetic vibration with tones corresponding in the number of vibrations with their length and tension. Thus the possibility was furnished that the nerve-fibres, terminating at the cells of Corti, of these strings were subjected to an atrophy by inactivity starting from the periphery, without forcing us to assume an inflammatory or degenerative process in the tissues of the cochlea.\* Also, the above-described alteration of the external hair cells in the first cochlear convolution might be referred to a similar atrophy developing from the periphery.

*The existing lymph-stasis may perhaps have contributed to effect the atrophy of the nerve.* As was more fully stated above, we found the perivascular lymph-sheaths in the first convolution dilated. However, we know from the investigations of Kühne and Rumpf† that the normal nutrition of the nerves depends not alone upon the integrity of their connection with the central organ, but also upon the nor-

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\* On account of the great analogy in regard to the atrophy by inactivity, we briefly report the following: Dr. Samelsohn exhibited at the meeting of the Niederrheinische Gesellschaft für Natur- und Heilkunde, in Bonn, January 19, 1880 (comp. *Berlin klin. Wochenschr.*, No. 23, 1880), the chiasma of the optic nerves of a man of 45, who had died of fracture of the base of the skull. The left eye had been atrophied for some time, and for this reason Dr. Samelsohn instituted an examination of the nerves. He found a remarkable atrophy of the left optic nerve and of both tracts, particularly the right one. Besides, the left globe had no longer any normal retinal elements. Horizontal sections of the chiasm, stained with carmine, yielded no difference in the coloration of the fibres. The thinned optic nerve was then divided into transverse sections, and it was proved that no *atrophy of the nerve-substance* existed anywhere. The septa were of the same width as those of the normal right nerve, nor was the connective tissue increased in any way. It had to be assumed, therefore, that *a part of the nerve bundles had perished without leaving a trace*—a process which has been already described by Leber as existing in the stumps of the optic nerves of atrophied eyes, while such a thinning of the entire nerve-trunk as far as the tractus, without atrophy of the single fibres, seems to have been demonstrated for the first time in this case.

† Zur Histologie der Nervenfasern und des Achsencylinders. Von Dr. Th. Rumpf. Untersuchungen aus dem physiologischen Institut der Universität Heidelberg, Bd. ii, H. 2.

mal connection of their terminal fibres with the formations innervated by them; in other words, that the latter, too, contribute to their nutrition. Moreover, Rumpf (*ibidem*) has found that nerve-fibres, which had been deprived of their normal connection by section, when immersed in lymph, showed a dissolution of their axis-cylinder even after a few hours. If we should be permitted to draw from these interesting investigations conclusions bearing on our case, it would seem plausible to interpret the above-described dilatation of the perivascular lymph-spaces in this sense, and to refer the surprising disappearance of the nerve-fibres within the lamina spiralis ossea, at least in part, as regards the axis-cylinder, to the effect of the stagnant, superabundant lymph. That such a lymph-stasis must occur in continued increased intralabyrinthine pressure is easily comprehensible if we bear in mind that the lymph-channels of the cochlea are in immediate connection, by endosmotic processes, with the remainder of the labyrinthine fluid.

We felt constrained to enter more fully into these investigations, although they have again been put in question by a paper quite recently published by Engelmann.\* Engelmann, namely, denies the dissolution of the axis-cylinder in lymph, and also the nutrition of the nerves from the terminal organs.

As regards the *varicose hypertrophy* found in the remaining nerve-fibres and their detritus, its satisfactory interpretation cannot easily be conformed to the above-described deductions. Perhaps it represents a transitional stage previous to the total disintegration of the fibre. The processes during an atrophy by inactivity, however, are for the present too little known to enable us to employ the hypertrophic condition in explanation of its development. Neither did we find in previous treatises on varicose hypertrophy of the nerve-fibres † any explanatory data, as they,

\* Ueber die Discontinuität des Achsencylinders und den fibrillären Bau der Nervenfasern. By Th. W. Engelmann, of Utrecht. *Pflüger's Archiv*, Bd. xxii, H. 1 and 2.

† Comp. a. Ueber Hypertrophie der Nervenprimitivfasern in der Retina. By H. Müller. *Gräfe's Archiv*, Bd. iv, 2, p. 47. b. Beiträge zur Kenntniss der varicösen Hypertrophie der Nervenfasern. By Dr. M. Roth. *Virchow's Archiv*, Bd. lv, p. 197. c. Krankheiten der Netzhaut und des Sehnerven. By Leber. *Gräfe und Samisch's "Handbuch,"* Bd. v, p. 578.

in the majority of cases, referred only to non-medullated fibres or processes of ganglion-cells, and throw no light upon the later condition of hypertrophic nerve-fibres.

The above-described atrophy of the nerve-fibres in the first cochlear convolution furnishes a pathologico-histological demonstration in favor of Helmholtz's theory of tone-perception. After Hensen had shown by comparative measurements that the radial length of the lamina basilaris membranacea increases in the direction from the fenestra rotunda to the cupola of the cochlea—according to Hensen it is about twelve times as large above as below,—Helmholtz thought himself justified in declaring that the nerve-fibres in the neighborhood of the fenestra rotunda served in effecting the perception of high tones, while those situated higher up were intended for the reception of lower tones. In fact, the result of the functional test,\* taken in connection with the pathological condition in the first cochlear convolution, is in full harmony with this hypothesis of Helmholtz. It, moreover, again confirms that the understanding of speech presupposes a normal perception of the higher musical tones. In this respect we refer to a paper published in this journal as early as 1872, by Moos.† Should the present observation and its explanation be confirmed by a more ample experience, it would acquire particular importance in a clinical point of view. Let us illustrate this by one instance, *i. e.*, auditory disturbances after cerebro-spinal meningitis. We know that this affection extends in either of two ways to the organ of hearing: through the petroso-squamous fissure into the drum cavity (Klebs, Moos), or through the porus acusticus internus into the labyrinth (Niemeyer, Heller, Lucæ, Knapp, and others).

\* Patient perceived the once-marked a, on the right side, neither by air, nor bone-conduction; while c' and c were perceived on the right side through the bone, and the latter also by air-conduction. Unfortunately, the test had been limited to these few tuning-fork tones, because the patient could be examined only *once* in the hospital on account of his great weakness and the speedy fatal termination. Concerning the test with the physharmonika, we desire to point out that it could certainly be of use in bilateral affection of the labyrinth; but, in cases of unilateral lesion, the difficulty of excluding the function of a normal ear by plugging of the meatus being well known, it could easily give rise to mistakes just on account of its intensity of tone.

† "Pathological Observations on the Physiological Importance of the Higher Musical Tones." ARCHIVES OF OPHTH. AND OTOL., iii, 1, p. 113.



Only the latter mode of extension enters into the present consideration. In this case either complete deafness exists, or, according to the present experience of Moos, *only the perception of high musical tones is destroyed or weakened*, and the understanding of speech correspondingly impaired. Possibly this may be due to the fact that the lower cochlear convolution is in such cases more particularly endangered than the upper two, because, on the one hand, the lower convolution is more easily reached when the morbid process extends from the cranial cavity; on the other hand, because the nerves between the bony plates of the lamina spiralis ossea suffer more particularly in their function from the pressure of the supposed exudation, since there they have to traverse a greater distance to reach the passage in the zona perforata than in the two upper convolutions.

#### *Historical Review.*

To aid the reader in appreciating the above-mentioned importance of the higher musical tones in the understanding of speech, we beg to add the following historical notes on this subject. In *Cannstadt's Jahresbericht* for 1872, on the progress of otology, Lucæ expresses himself to this effect:

“From some cases of affection of the inner ear reported by Moos it appears that the higher tones seem to have greater importance in the understanding of speech than the lower ones; further, in many so-called nervous affections of the ear, the answer to the question, whether a patient hears the higher musical tones clearly, faintly, or not at all, may concern likewise the prognosis regarding a possible restoration of the acuity of hearing for speech. The test was made with a piano of seven octaves. The reviewer can confirm the author's statements from his own experience, but begs to remark that, in the examination, the physharmonika, owing to the greater intensity of its higher tones, furnishes more reliable results than the piano.”

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\* See above, l. c., p. 113.

In *Cannstadt's Jahresbericht*, 1874, p. 634, Lucæ makes the following remarks in regard to further observations by Moos : \*

"In the *Jahresbericht* for 1872, the reviewer has already confirmed the author's observations, but he cannot concur in their above-mentioned prognostic value. According to the investigations of reviewer, extending over several years, the complete perception of the whole gamut is essential to a normal comprehension of human speech. Therefore, if there exist anywhere a defect of tones or a material impairment of the perception of tones, it would generally have an injurious effect upon the understanding of speech, without for the present enabling us to say positively whether it is prognostically favorable to possess a particularly acute ear for this or that section in the gamut."

In a later essay,† concerning a man aged 45, quite deaf from his sixth year, with speech like that of a deaf-mute, and at the same time blind from retinitis pigmentosa, Lucæ expresses himself as follows :

"There can be no doubt that the complete loss of the higher musical tones, to which the normal acoustic nerve reacts most sensitively, with certainty indicates an affection of the inner ear. In this respect I refer to the observations on the total loss of the higher musical tones published by Schwartze, Moos and myself."

He then recommends again the physharmonika as the test instrument, and reports two cases. The first case was dissected eighteen days after the examination. During life the low tones from *c'* downward were perceived much better than the high ones, and words only when spoken loudly and directly into the ear. It could not be positively determined whether the hearing on the right side was better than on the left. At the autopsy, the condition found was mainly that of chronic catarrh of the middle ear, on both

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\* On defective perception of certain consonants, combined with a similar defect as regards high musical notes ; with the physiological significance of the same. ARCH. OPHTH. AND OTOL., vol. iv, p. 469.

† Die bei Schwerhörigen zu beobachtende gute Perception der tieferen musikalischen Töne und die physiologische und diagnostische Bedeutung dieser Erscheinungen, nebst Section zweier bei Lebzeiten beobachteter Fälle. *Archiv f. Ohrenheilk.*, Bd. xv, H. 4, pp. 273 *et seq.*

sides, of the secretory form; further, the *striae acusticae* hardly developed at all, and the acoustic nerves in general normal, only the fibres of the left nerve slightly paler and narrower. In both *sacculi commun. et rotund.* were a large number of black concretions of lime. They were looked upon as the residues of an inflammation of the labyrinth which had run its course in the first years of life. The fact that the patient during life did not hear whispered speech or faint noises is explained by Lucaë, in accordance with Helmholtz's theory, by the coarse alterations in the vestibule; while, in his opinion, the rather well-preserved perception of musical tones found its explanation in the fact that no such coarse alterations were present in the cochlea. "But just why the lower tones were heard more easily than the high ones, I am, of course, unable to determine." Should, perhaps in this case, too, a portion of the nerve-fibres in the first cochlear convolution have disappeared?

In the second case likewise (comp. the original, l. c.), Lucaë thinks we might draw the conclusion, bearing Helmholtz's theory in mind, that not all the fibres "of the portion of the cochlea affected with atrophy had become unable to functionate, unless we prefer to seek the reason for that symptom in the still almost normal condition of the vestibular branch." It is to be regretted that Lucaë did not undertake a careful examination of the condition of the nerve-fibres in the different cochlear convolutions; perhaps he would then have been enabled to give a positive instead of a hypothetical explanation of the disturbance of function observed during life. It is difficult to understand how we could harmonize the atrophy of the left vestibular branch, described by Lucaë, with the above-mentioned functional disturbances.

#### *Explanation of Figures.*

In order to facilitate a comparison of the atrophic portions of the nerves with the healthy condition, we had the normal proportions of the nerve distribution in the first cochlear convolution drawn in figs. 1 and 3. The petrous bones serving for the nor-



mal preparations have been decalcified in precisely the same manner as that of Gref.

Fig. 1.—Hartnack obj. 2, eye-piece 3. A segment of a surface preparation of the lamina spiralis ossea from the first convolution of the left cochlea of a man of 19, with normal hearing, who died of pneumonia. We see some of the larger bundles of nerve-fibres, immediately after emerging from the modiolus, in their course toward the commencement of the lamina spiralis membranacea, dividing into smaller branches. By numerous transverse anastomoses between the main trunks and their branches, a net is formed with predominating narrow meshes.

Fig. 2.—A segment, likewise from the first cochlear convolution, of the right petrous bone of Gref, *under the same magnifying power*. The single bundles of nerve-fibres, immediately after emerging from the modiolus, and in their course to the lamina spiralis membranacea, are narrower and consequently present a lighter appearance. The transverse anastomoses are less numerous than in fig. 1, and the network formed by them, therefore, has wider meshes.

Fig. 3.—A vertical section through the lamina spiralis ossea, membranacea, and the organ of Corti supported by it. Preparation from a woman of 42, with normal hearing, who had died of tuberculosis. Hartnack obj. 4, eye-piece 3. We see the nerve-fibres situated between the two plates of the lamina spiralis ossea, in their course toward the introitus (*d*), in front of the inner pillar of the organ of Corti. They form a bundle widest toward the inside, gradually decreasing as it approaches the place named. *mr*, a fractional part of the membrane of Reissner. *cs*, crista spiralis. *ri*, region of the internal hair cells. *ra*, region of the external hair cells.

Fig. 4.—Vertical section *through the same region* of Gref's right cochlea, same magnifying power. Instead of the dense nerve-bundle, we see only exceedingly sparse, isolated, chiefly radial nerve-fibres. Where these are interrupted by vacuolæ, we see transverse sections of some spiral fibres which we have designated above as transverse anastomoses.

Fig. 5.—A segment of the surface preparation No. 2. Hartnack objective No. 9 (immersion), eye-piece 3. We see partly single, partly aggregated, as well as radial and spiral remnants of nerve-fibres which appear as if torn off. All of them still have a double outline and exhibit partly fusiform, partly club-shaped

swellings interspersed with contractions. The varicosities are mainly caused by expansion of the axis-cylinders. Besides, in some places the nuclei of Schwann's sheath are enlarged. Some of the varicose-hypertrophied nerve-fibres contain still a roundish or irregularly shaped, sometimes brighter, sometimes darker corpuscle.

Fig. 6.—Hartnack obj. 4, eye-piece 2. We see the perivascular lymph-sheath of a blood-vessel from a surface preparation of the lamina basilaris membranacea of the right petrous bone of Gref. The diameter of the perivascular lymph-space on each side of the vessel equals about double the calibre of the blood-vessel.

## A RARE CASE OF STAB-WOUND OF THE LEFT HALF OF THE SKULL,

WITH TEMPORARY IRRITATION OF THE LEFT OCULOMOTOR  
AND VAGUS NERVES, AND PERMANENT (?) PARALYSIS OF  
THE LEFT FACIAL AND ACOUSTIC. USE OF TUNING-  
FORK TESTS IN THE DIAGNOSIS OF INJURIES OF THE  
SKULL.

BY S. MOOS, OF HEIDELBERG.\*

Translated by ISIDOR FURST, of New York.

"A college boy, æt. 17, son of a physician, was stabbed, March 19, 1880, shortly after 7 P.M., with a knife, the point of which had been broken off previously. The wound was in the left half of the skull, midway between eye and ear, and at the level of the frontal sinus. The blade was so firmly impacted that it could be withdrawn only by a vigorous pull of a comrade (who, however, could not remember how deeply the knife had penetrated into the skull). The wounded young man did not lose consciousness, but grew 'almost maniacal,' fell on his knees and vomited copiously. I saw him on the following day at ten o'clock, or fifteen hours after the infliction of the injury, and found continuous vomiting, a cephalic pulse of 60, paresis of the left facial nerve, deafness of the left ear with loud tinnitus, and slight luscitas (diverging), but no diplopia. The wound was covered with a bloody scab, and three-fourths healed by first intention. Ice applications had been employed. I transported him, during two hours, partly by coach, partly by rail. The vomiting soon ceased; the other symptoms continued. On March 21st patient had one temporary attack of diplopia; since then neither that nor diverging strabismus. But after the fever—highest evening temperature  $39.6^{\circ}$ —had subsided

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\* Paper read before the Second International Otological Congress at Milan, September 7, 1880.

in two days, the cephalic pulse became more ominous: 48-42 beats; on the 25th, during an attack of violent pain in the *anus* and *forehead*, it even sank to 36, and up to date (April 3d) it has remained constant at 48. To-day, as on the first day, the watch is heard only when firmly pressed on; loud speech, in immediate proximity (possibly by means of the right, though plugged ear); membrana tympani intact. The left facial nerve is still paralyzed. Tinnitus in the left ear. Patient is otherwise perfectly well."\*

My advice as to therapeutics having been asked, I recommended, as soon as the fever should have permanently subsided, the internal exhibition of potassium iodide,† and galvanization of the acoustic nerve and of the muscles supplied by the left facial.

A second letter from his father, which the patient brought me on April 24th, contained the following:

"Parallel to the stab-wound, which has healed by first intention, about  $\frac{1}{2}$  cm. to the rear, we can feel a prominent osseous cicatrix. From April 9th to 12th, pulse 50 to 60; since then, 60 to 70. Potassium iodide since April 13th. The left facial nerve remained equally paretic from March 19th to date. From the 10th to the 16th Störer's magneto-electric rotation apparatus was employed daily. For the past two weeks, contraction of the right half of the face.

"Up to a week ago there was left-sided tinnitus of varying intensity, which has greatly moderated since then. At times the hearing seemed a little better, so that the watch could be heard when lightly applied (with the right ear?). On April 16th and since then he could not hear whispered speech, nor even through an ear trumpet.

"Heart-beat, pulse, etc., normal. Subjective condition good."

When I particularly inquired whether the disturbances in the region of the left facial and acoustic nerves had been observed *immediately* after the injury, the physician who had attended during the first fifteen hours gave the following information:

"I can make the favorable report that up to March 20th, 10 A.M., when I last saw the patient in presence of his father, no nervous paresis had occurred, excepting a certain impairment of

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\* Report of the father.

† During the first seven weeks after the injury 100 grammes were taken altogether.

hearing which, however, I interpreted more or less as a symptom of slow reaction in consequence of general cerebral stunning produced by the shock from the vigorous thrust, in connection with some inebriety."

On the other hand, on further inquiry, the patient's father expresses himself thus, under date of May 6th :

"I firmly believe in the *immediate* occurrence of the main symptoms. If I did not ascertain everything at once on *first* seeing my son, you will admit that here the father placed the physician in the background ; the more so as I did not know then that the point of the knife *had been wanting previous to the injury*."

"The impaired hearing certainly existed during the transportation to this place, for my son heard nothing at all when lying on his right ear. I distinctly remember that a change of the face struck me at first sight ; but I had not interpreted this fact immediately and clearly to myself as a paresis of the facial nerve."

*Status præsens*.—April 26th, 11 A.M. Complete paralysis of the facial nerve. A reddish scar, 13 mm. long, 3 mm. broad in its greatest diameter ; its anterior lower end is 6 cm. from the left outer canthus, and the same distance from the upper end of the left tragus. Beside and behind the place of injury, the above-described osseous cicatrix. The pupils are equal. Right nostril oval, larger than the left, which is more like a fissure. The upper and lower lips are drawn to the right. *Uvula* and *soft palate* normal in position. Salivary secretion normal. According to the measurements with the æsthesiometer, the sensibility of the left half of the face, when compared with the right, is rather increased. The points are perceived as double when 22 mm. apart, as single at shorter distances.

Test of the *sense of touch and taste* of the anterior two-thirds of the tongue. Sense of touch normal. The *sense of taste* appears lost on the left half of the tongue when tested with solutions of sugar, quinine, acetic acid, and salt. Sugar solution is perceived as water.

Of this disturbance the patient was hitherto unaware from his experience.

Result of the test of the *left organ of hearing* :

Tuning-forks in bone-conduction are perceived only on the healthy side, not on the left ; the same in air-conduction. This

is true also for acoumeter and watch. On plugging both ears, patient understands speech at a distance of  $\frac{1}{3}$  metre; at the same distance with the left ear open. *The power of hearing, therefore, is lost on the left side*; withal, there exists constantly a slight noise in the left ear, which, at first more occipital, has gradually approached the left ear, and has latterly increased in intensity.

The anterior wall of the auditory meatus, by its strong inward projection, hides the anterior half of the membrana tympani. Vivid injection of the vessels of the manubrium mallei. Through the normal posterior half of the membrana tympani, the long crus of the incus is perceptible. Pulse 84, temperature  $36.7^{\circ}$ . Patient had suffered from occasional constipation before the injury; otherwise healthy.

*Detailed Description of the Instrument with which the Injury was Inflicted.*

By my request, the instrument was sent to me for one day by the justice who tried the case.

Length of the knife-handle, 11 cm.

Length of the blade, 7.7 cm.

Breadth of the (broken) point, 4 mm.

Breadth of the blade at a distance of  $1\frac{1}{2}$  cm. from the point, 1 cm

Breadth of the blade farther toward the handle, 1.3 cm.

Breadth of the back of the knife at the point, 1 mm.

Breadth of the back of the knife in the middle, 2 mm.

Breadth of the back of the knife near the handle, 3 mm.

*Result of the Examination and Treatment with the Constant Current. Further Course of the Affection.*

The electro-muscular contractility in the region of the muscles supplied by the left facial nerve is nearly extinct. During the employment of the constant current, a subjective sensation of taste occurs. With twelve Siemens-Halske elements and external connection, a vivid ringing occurs on cathode closure, which persists a short time during the cathode duration, and returns with the anode opening.

CC = R'

CD = R

CO = O

An C = O

An D = O

An O = R



This formula proved constant in the course of many weeks, no matter whether the one electrode was on the tragus, and the other in the hand of the respective side, or the one on the tragus and the other on the left ala nasi or on the respective half of the forehead or face.\*

At all events, from the reaction of the auditory nerve to the electric current, the conclusion could be drawn that no absolute paralysis of it was present. The electric treatment of the auditory nerve afterward took place in the voltaic alternation, with gradual diminution in the anode; that of the muscles supplied by the left facial nerve, partly with stable, partly with unstable currents.

At first there was occasional frontal pain and repeated constipation; but the cerebral functions remained unimpaired, so that, with the exception of two days, patient could successfully pursue his customary studies.

*June 22d.*—After forty-four applications of the constant current, the paralysis of the facial nerve was still the same as on April 26th, as were the disturbances of taste in the anterior two-thirds of the tongue; solutions of sugar and quinine were not tasted at all, acetic acid as bitter, saline solutions as acid.

In regard to the organ of hearing, however, the following was noticed:

With ears free, *c* from the forehead is heard in the occiput; *c'* and *a*, on the right side; but when the left ear was plugged *a was heard on the left, and the other two on the right.* Whispered speech with both ears closed was repeated at a distance of 1 metre; *with right ear closed and left ear open, at 3 metres.* Obviously the left organ of hearing was recommencing to hear, and, moreover, in a very favorable manner; there was present, though still in an impaired degree, *bone-conduction for high tones.* This test was repeated on the following day with precisely the same result.

*June 25th.*—When both ears are closed, patient does not hear *a* and *c* at all by air-conduction, but he hears *c'* (obviously only on the right by transmission through the bones of the skull).

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\* This forms a confirmation of Brenner's statement, who says: "*Concerning the distance of the two electrodes from each other, I have already demonstrated (comp. 26th exper.) that a certain proximity of both renders the excitation of the auditory nerve impossible, because the coverings of the nerve, forming a secondary closure, prevent the current from acquiring a sufficient intensity. However, should the nerve be in a state of hyperæsthesia, then the electrodes can be brought much closer before a cessation of the reaction occurs. At times such a cessation cannot be obtained at all.*" (See "*Versuch zur Begründung einer rationellen Electro-Otiatrik,*" Leipzig, 1868, p. 185.)



By bone-conduction (from the forehead), with left auditory meatus closed, he hears *all tuning-forks on the left side*; with both ears open, c in the occiput, c' and a on the right side. Hence there was present (though impaired) bone-conduction for deep tones likewise. By *air-conduction*, a is perceived now in front of the left ear; Politzer's acoumeter at a distance of 2 cm.

*From June 26th to July 9th, inclusive.*—Ten sittings. Interruption of the treatment on July 3d and 4th on account of violent frontal pain and incapacity for mental labor.

*July 5th.*—There appeared the first indications of a decided improvement in the electro-muscular contractility in the region of the paralyzed facial muscles. When requested to wrinkle the forehead, the folds extended farther beyond the median line than before; the left eye closed more perfectly; dropping of tears is rare; patient is able to whistle some.

*July 7th.*—Patient states that after closing his right ear he had heard his watch at a distance of one inch from the left ear.

*July 10th and 11th.*—Headache; forehead and vertex are the seat of a dull pain; there is also constipation. Remission after the use of bitter water.

*July 12th to 17th.*—Treatment with the constant current as before.

*Status on July 17th.*—Condition of the muscles supplied by the left facial nerve as in the first week of July. No improvement in the tasting capacity of the left half of the tongue.

Condition of the left auditory organ:

With both ears closed, speech heard at 5 metres.			
"	"	whisper heard at 3	"
With right ear closed and left ear open, speech heard at 12 metres.			
"	"	whisper	" 8 "
"	"	acoumeter	" 0.10 "
"	"	tuning-fork c	not heard.
"	"	" c'	heard at 0.06 metre.
"	"	" a'	" quite near.

Bone-conduction with ears free:

The above-named tuning-forks from the forehead are all perceived behind the right ear; when the left ear is closed, more toward the occiput.

*From July 19th to 28th.*—Treatment continued. Headache, frontal and parietal, on July 22d and 26th. Termination of treat-

ment by myself on July 28th. Thereafter it is to be continued at home by the patient's father.

Result of the *last* examination and test on July 29th :

The electro-muscular contractility of the paralyzed muscles has increased of late, inasmuch as the muscles of the mouth contract more strongly than formerly on electrical irritation. *The contrary obtains with all the muscles of the nose* which do not react at all to the electric current. That the muscular tonus of the left half of the face has improved may be recognized also from the increased fulness of the face ; it no longer appears so collapsed, the contraction of the right half of the face is much less conspicuous than before. The sense of taste on the anterior two-thirds of the left half of the tongue is still as before. Only acetic acid, after repeated tests, is perceived as "bitter ;" the other substances as indifferent.

*Condition of the organ of hearing : Bone-conduction*, when both ears are closed, *all tuning-forks heard on the right* ; the same when *right ear alone* is closed. This condition is *reversed* when the *left ear is closed*. *Acoumeter* : From the left temple heard very distinctly on the left side ; when the right ear is closed and the left open, at 0.17 metre.

Whispers, both ears closed, at 5 metres.

" left ear open, " 9 "

In reference to the localization of the source of the sound, some mistakes are still committed : six times in seven tests patient thought that the sound came from the right when it came from the left.

There is still some hyperæmia of the vessels of the manubrium mallei on the left side, and a continuous low tinnitus. The dropping of tears is changeable, sometimes present, sometimes not, never excessive.

In order to form an idea of the anatomical alterations provoked by the injury, and to make a more exact diagnosis in conformity therewith, the *settlement of a preliminary question was of importance* in the first place. Did the disturbance in the region of the left facial and auditory nerves *occur immediately or on the day following* the injury?

In this respect I have again entered into correspondence with the patient's father, and the latter, on his part, with the physician who had first attended. The result of these

inquiries, the details of which it would not be desirable to repeat in this place, has inclined me to the opinion *that the disturbances in the region of the facial and auditory nerves followed immediately after the injury*. I therefore do not hesitate to form a diagnosis of *fissure in the left petrous bone*. Possibly there were also circumscribed extravasations of blood in other parts, as in the region of the vagus and oculomotor nerves. To these may have been due the temporarily slowed pulse and the attack of diplopia. But it may be that the slow pulse was a consequence of the concussion accompanying the injury,\* and that the diplopia was due to a fissure of the orbit at the point of entrance of the oculomotor nerve.

If the disturbances in the region of the seventh and eighth cerebral nerves had really occurred as late as twelve to twenty-four hours after the injury, then their appearance could be capable of but a forced explanation, even taking into consideration the probable presence of an extravasation of blood.

According to the preceding detailed description, the point of injury was rather far in front, possibly at the suture of the squama of the temporal and the sphenoid bone; the instrument, which was broken previous to the stabbing, could not have penetrated into the brain substance proper;† at most it might have reached the dura mater at that point where there is no arterial blood-vessel of larger calibre. Should, however, the case have been by accident one of an anomaly—the existence of an abnormally large branch of the meningeal artery—and in consequence thereof a considerable hemorrhage have been possible, then, in order to effect the nerve-paralyses (of the facial and acoustic nerves), a descent of the blood as far as beneath the tentorium cerebelli must have taken place. That could not have been possible without some symptoms of cerebral compression, nor without a series of local and general disturbances, such as have been recently collected and described in the March

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\* According to Dupuytren: "The slow pulse is not, by some authors, considered as characteristic of *commotio cerebri*." Vidal-Bardeleben, "Chirurgie."

† In that case, protracted fever, peripheric motor and sensory disturbances would not have been wanting.

and April (1880) numbers of the *Revue mensuelle* by Gérard Marchand, who gives a very full account of his own and other observations on disruption of the medial meningeal artery in injuries to the skull.

*These symptoms are:* Diffuse œdema in the temporo-parietal region; very intense pain on pressure on one spot; ecchymosis occurring some time after the injury, occasionally in the region of the mastoid process, sometimes in the zygomatic region; at times dilatation of the pupil on the injured side. Among the general symptoms Marchand emphasizes as the most constant—stertor. Ordinarily the patient is comatose, and early exhibits the symptoms either of cerebral irritation or of compression. Associated therewith are signs of contraction of muscles, relaxation, etc., in the most varied combination.

*Supposed Position of the Fissure.*

Taking into account the disturbances, after the injury, in the region of the facial and acoustic nerves, and the course of the affection, we may, in attempting to locate the fissure, particularly consider two places—namely, the porus acusticus internus or that region of the petrous bone which includes the first bend of the facial nerve and the osseous cochlear capsule contiguous to it.

If we assume a fissure in the region of the first bend of the facial nerve and the adjoining region of the cochlear capsule, together with an exudation or extravasation, we can explain the successive improvement of the hearing for tones, first for the higher, then for the lower ones, on the basis of Helmholtz's theory of tone-perception which teaches that the nerve fibres in the neighborhood of the fenestra rotunda serve for the perception of high, and those in the cupola of the cochlea for the perception of low tones. We may suppose that the exudation and extravasation in the neighborhood of the fenestra rotunda, a more deep-seated region, were less considerable, and for that reason absorption was easier and was completed earlier.

If we, on the other hand, make a diagnosis of fissure of

the porus acusticus internus, we could explain the just-described phenomena during the convalescence only by the assumption of *an isolated conduction in the auditory nerve*. Therefore, despite the copious transverse anastomoses of the nerve bundles situated between the plates of the lamina spiralis ossea, an isolated transmission of the single musical tones would have to take place as far as the musical centre of hearing. We would then be forced to imagine that an exudation or extravasation of blood, simultaneously effused with and through the fissure in the internal auditory meatus, at first caused the paralysis of both nerves, and that, in regard to the acoustic nerve, by the absorption during the course of the affection, those fibres which transmit the high musical tones were first set free.

I must confess that the former assumption is much more probable than the latter. It corresponds more nearly with surgical experience and the experiment concerning the relation of fissures to the point of attack. "Aran, Trélat, Masse and St. Pierre, as well as numerous other authors, have experimented in this sense and with the same result. Aran thus formulated the law, named after him, for the course of fissures produced in this manner: '*They commence at the point of injury and from there extend regularly on the shortest route to the base.*'" (See "Deutsche Chirurgie" by Billroth and Lücke. No. 30. By Prof. Dr. E. von Bergmann. "Die Lehre von den Kopfverletzungen," p. 193.)

If we take into consideration the point of attack in our case, the distance to the porus acusticus internus is certainly the greater, no matter which one of the well-known directions the fissure took in the middle cranial fossa—whether a transverse\* one or one parallel to the pyramid of the

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\* In my collection (No. 70), there is a preparation of a *transverse fracture of the petrous bone* in a boy of 12. He was brought, five hours after a fall on his head—a distance of 16 feet—on July 12, 1862, to the Child's Hospital of this city, in a state of sopor. *There was no visible external injury*, and he remained soporose until the evening of July 18th. At the autopsy there was found: "Hemorrhage of the dura and pia maters. Capillary hemorrhages in the cortex cerebri. Fracture of the sphenoid bone, of the temporal squama, and of the petrous bone." On the *dry* osseous preparation, kindly presented to me subsequently by Prof. v. Dusch, is seen a complete separation of the pyramid. The fracture extends 3 mm. behind the quite intact porus acusticus internus, in a somewhat oblique direction, through the vestibule, the roof of which is partly



petrous bone.\* Moreover, the mass of bone to be separated by a fissure in the porus acusticus internus is a thicker (perhaps also denser?) one than in the first-named region. Finally, the assumption of an isolated transmission of single tones to the musical centre of hearing, in the described condition of the transverse anastomoses of the nerve fibres in the cochlea, is rather forced and lacks confirmation.

In reference to two cases of facial paralysis published by Erb as early as 1870,† we must make special mention of one circumstance. We have stated under the head of *status præsens*: "Uvula and soft palate normal." Erb, in one of his cases arising from trauma, besides the other symptoms of paralysis of the facial nerve, has observed also paralysis of the sense of taste and of the velum palati, and argues from the latter circumstance that the seat of the injury must have been above the place of origin of the petrosus superficialis major nerve, that is above the ganglion geniculi, because this nerve supplies the soft palate. If this argument were absolutely correct, we could certainly assume that in our case the seat of the fissure, leaving the cochlea aside, was between the ganglion geniculi and that section of the canalis facialis which extends above the stapedial region. However, the innervation of the velum palati by the petrosus superficialis major nerve is not quite certain. According to Henle ("Handbuch der Nervenlehre des Menschen." Braunschweig, 1871, p. 403), the anatomical investigations into the course of the fibres of the last-named nerve have led to contradictory results. Compare (*l. c.*) his quotations from Cloquet, Varrentrapp, Longet, Calori, Rauber, Beck, E. Bischoff. The observation of the oblique position of the uvula in unilateral paralysis, the cause of which lies in the central organ or in the temporal bone, according to him, indicates that the palatine muscles

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forced off, through the fenestra ovalis, through the promontory, the fenestra rotunda, the floor of the tympanic cavity, through the middle of the jugular fossa. I am unable to present further details, but it is probable that the facial nerve and the soft parts of the vestibule were lacerated.

\* Concerning the direction of basis fractures in the medial cranial fossa, comp. v. Bergmann, *l. c.*, p. 195.

† *Deutsches Archiv f. klin. Med.*, Bd. vii.

receive their nerves *in part* from the facial, and moreover, as this supply is possible only by way of the geniculum of the last-named nerve, through the nervus petrosus superficialis, the nasal ganglion and the palatine nerves, the petrosus superficialis major nerve must contain motor fibres which extend from the ganglion geniculatum to the ganglion sphenopalat. "The direct experimental demonstration, however, has not been furnished with the certainty to be desired." Compare, *l. c.*, the respective quotations from Debrou, Valentin, Nuhn, Longet, Volkmann and Hein, which are in part contradictory to each other. In the case of Waschadka, which will shortly be published in these ARCHIVES, and in which, in consequence of caries of the petrous bone, paralysis of the facial nerve occurred several weeks before death, *there never was any paralysis of the uvula or of the soft palate, and yet the autopsy demonstrated that the facial nerve was totally destroyed from the ganglion geniculi centrally as far as the internal auditory meatus.*

Perhaps it may be possible to solve these apparently contradictory observations in a similar manner as those of the sense of taste. There, too, facts were present which tended to put in question the function of the branches of the facial nerve passing through the chorda to the lingual nerve as fibres which serve for the sense of taste in the anterior two-thirds of the tongue, until Schiff demonstrated (Moleschott's "Untersuchungen," Bd. x, pp. 406-422) that the lingual nerve has other fibres of taste which do not extend to the chorda—namely, nerve anastomoses between the second and third branches of the fifth nerve and the otic ganglion, which, in Schiff's opinion, contain, in different individuals, fibres of taste in varying number, so that sometimes one, sometimes the other of those connections forms the main conduction. Concerning our case, in particular, the lingual nerve of the injured side can have contained only such fibres of taste as belong to the facial nerve, and that alone. In this respect we refer to the above reports regarding the paralysis of taste in the anterior two-thirds of the tongue on the injured side, given in the history.



*Literature.*

In the second edition of the "Lehrbuch der Chirurgie," by Vidal-Bardeleben, Bd. iii, 1860, p. 61, we read: "Chas-saignac, in his *thèse de concours*, has collected observations on injuries to the olfactory, optic, oculomotor, facial, auditory, glosso-pharyngeal, vagus, hypoglossus and other nerves."

This thesis (Des plaies de la tête, Paris, 1842) I have been unable to obtain either at the Heidelberg or Strassburg Library. I should have liked to inform myself whether combined paralysis of the facial and acoustic nerves, *in consequence of fissures* in injuries to the skull, are of frequent occurrence. In injuries of the skull with fractures of the basis cranii, paralysis of those two nerves is not very rare,\* and not infrequently such paralytic affections get well even after several years' duration. Thus Bruns† relates a case in which, after the lapse of three years, the paralysis of the facial nerve began to disappear gradually, seriatim from below upward, so that the eyelids could not be properly closed until the fourth year. Deafness, however, persisted. Assuredly Bruns is right when he says (*l. c.*, p. 329) that we must beware lest we refer every such paralytic symptom back to contusion or laceration of the respective nerve by a cranial fracture; because it might have been produced by various other factors, for instance, pressure by extravasations of blood within the cranial cavity, by lesion of their central termination at or within the cerebrum.

I refrain from further citations. Those who, by observations similar to the present, should be placed in the position

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\* Rather the most frequent of all cerebral nerves, generally by disruption; most frequently both are torn simultaneously, more rarely the facial nerve alone, and still more rarely the acoustic nerve alone. Bruns, *l. c.*, p. 329:

"In fractures of the base the paralysis of the facial nerve, either with or without coincident paralysis of the acoustic nerve, is the best-known nerve lesion, and is recognized already by the older writers as an important aid in diagnosis. In 24 fractures of the base of the cranium, Leisrink (*Langenbeck's Archiv*, Bd. xv, p. 55) has noticed paralysis of the facial nerve five times, and once of the facial and acoustic nerves. In 49 cases collected by Schwartz, there occurred paralysis of the facial nerve fourteen times, and the same number of paralysees of the acoustic nerve. In five of these cases the paralysis affected both nerves together." Bergmann, *l. c.*, p. 404.

† "Handbuch der Chirurgie," Bd. i, p. 325.

of having to consult a more extensive compilation, can be cordially referred to the above-named treatises of v. Bruns and v. Bergmann; they present a rich material of personal and foreign observations, and furnish an equally ample and instructive synopsis of the contributions of authors who have made a specialty of the study of injuries to the skull.

# A CASE OF TREPANATION OF THE MASTOID PROCESS; DEATH BY MILIARY TUBER- CULOSIS.

BY H. STEINBRÜGGE, OF HEIDELBERG.

Translated by WILLIAM C. AYRES, M.D.

*(With a curve of temperature. Table II.)*

H. S., a boy of five years had been suffering from an affection of his left ear since the fall of '79. Under the symptoms of an acute catarrh of the stomach, he began to complain of pain in the left ear, which three days later was followed by a discharge of pus, sometimes mixed with blood, but which, however, did not lead to any change in his general condition.

Prof. Moos was consulted for the first time on April 23, 1880. At that date the auricle stood out from the head; regio mastoidea normal and not sensitive on pressure; there were multiple polypi in the external canal. On April 29th many large and small tumors were removed with Wilde's snare, under chloroform narcosis, and the remains of the tumors which sprang in part from the tympanic cavity were treated with galvano-cautery. Between this and the fourth of May, necrosed granulations came from the ear spontaneously. On May 8th the left mastoid process was red, swollen, and excessively painful, the auricle standing out from the head more prominently than before. Painted with tincture of iodine. On May 11th an abscess formed on the posterior superior wall of the canal, and in the sanguino-purulent mass evacuated was a quantity of elastic tissue. The pain disappeared immediately after, but pus was still evacuated upon pressure. On June 24th the pain returned, the mastoid process was swollen, and Wilde's incision was made on July 1st under

chloroform narcosis. The knife sank easily into the decayed bone, and a solution of boracic acid which was injected into the canal flowed out through the wound, and a few days later it could also be forced through the wound into the canal. The subsequent course was satisfactory. Had a cough since July 12th. The fistula began to close in the beginning of August, and as the boy lived in the country he did not come for treatment for several weeks. He was afterward taken with a fever, and contracted a peritonitis.\*

On Sept. 11th I saw the boy for Prof. Moos. He had recovered from the above diseases, and did not complain of his ear, although the fistula had so far closed as to render it difficult to force the fluid from the meatus through the opening. On Sept. 24th the father came to me and informed me that his son had been suffering with chills, headache and vertigo since the 19th of the month. The chills seemed to originate in his head, and cold applications were disagreeable to him. He began to perspire, was restless and startled in his sleep, sleepy during the day, apathetic and taciturn, vomited, had a coated tongue, and was constipated. On Sept. 23d a passage was brought about by a soap suppository. His cough, which had disappeared for a time, returned.

As the symptoms were becoming alarming and an operation was under consideration, I requested Prof. Lossen to accompany me in my visit to the patient. On the evening of the same day we found him pale and lying drowsy in his bed. Pulse 64, small and intermittent; temperature  $37.2^{\circ}$ . Pupils wide, and reacting slowly to light. The vomiting had continued daily, and he constantly complained of headache. Since there was evidently a beginning cerebral complication, which demanded a free passage for the pus externally, we advised the parents to send the boy to Heidelberg for further treatment.

The following morning he was brought to the ear clinic, where we found that his condition was the same as that of the previous day. He had slept very restlessly, had vomited, and complained of a hammering sensation in his head. Pulse 70, temperature  $38.3^{\circ}$ , but there had been no return of the polypi. After chloroform narcosis I could pass a probe  $2\frac{1}{2}$  cm. into the fistula of the proc. mastoideus in the direction of the antrum, probably into

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\* The case is from the private practice of Prof. Moos who, being absent from the city, entrusted the patient to my care, and kindly permitted me to publish the case.

the cavity. A vertical incision was made under antiseptic precautions between the auricle and the former fistula down to the periosteum. The periosteum was dissected back on both sides, and the anterior wall of the fistula chiselled away, so that a sharp-edged spoon could be brought into the cavity and the bone cleanly scraped. On the injection of a 1-per-cent. solution of carbolic acid, the fluid could be passed both ways from the external canal through the wound, and *vice versa*. The wound was bandaged with carbolic and salicylic wadding.\* No collection of pus nor movable sequestrum was discovered.

*Two o'clock in the afternoon.*—The immediate effect of the operation was very good; probably on account of the bleeding; the boy spoke fluently, had a good appetite, and said that his headache had entirely disappeared. It returned, however, in the afternoon, and his pulse sank again; he drank often, and vomited three times. In the evening: Pulse 70, temp. 38.3°. Ordered ice-bags and suppositories.

*Sept. 26th.*—He passed a quiet night, vomiting only twice. Pulse 64, temp. 37°. No evacuation of his bowels. Loss of appetite, coated tongue and dry lips. Belly soft and not sensitive to pressure nor drawn in. Bandage changed; syringing with 2-per-cent. solution of carbolic acid. Abundant urination; the color of the face alternated from pale to flushed. Ordered castor oil and ice bags. In the evening, passage produced by enema. Pulse 76, temp. 37°.

*Sept. 27th.*—Passed a good night. Pulse 70, temp. 36.8°. In the afternoon, 38.0°; evening, 37.2°. No decided change.

*Sept. 28th.*—Had chills during the night and passed his urine in bed. Headache. Ice bags refused. Ordered Seidlitz powder. Pulse 56, temp. 37°. Afternoon, 38.4°; evening, 38.2°. Groaned frequently and called continually for his father, although he was sitting on the side of the bed. Ordered calomel 0.12 grammes every two hours.

*Sept. 29th.*—In a drowsy condition. Defecated and urinated in bed. Drinks frequently; extremities cold; gnashes his teeth at times. Highest temp. 38.6°. Pulse intermittent, and in the evening, 96°.

*Sept. 30th.*—Pulse 116 temp. 38.2°. Eyeballs oscillating, especially the left; pupils dilated; twitching of the muscles of the right arm. The flexors of the left somewhat contracted; passed

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\* Prof. Lossen, of Heidelberg, and Dr. Werner, of Schwetzingen, kindly assisted me in the operation.

his stools in bed. Afternoon, pulse 120, temp.  $39^{\circ}$ . Face dark red. He eats ravenously, devouring large quantities of biscuits, but does not use his hands, taking them simply in his mouth. If he is not fed he bites at the wadding of the dressing, or chews the bed clothing. His power of vision seems diminished, but he evidently hears well. Ordered six leeches on his right mastoid process, and ice-bags. In the evening, pulse 128, temp.  $38.2^{\circ}$ . After the leeches, somewhat quieter, but only for a short time. Ordered bromide of potassium 1.0 grammes. Ice-bags. Neither the left ear nor the wound shows any peculiarity. The wound secreted but little, had a good aspect, the carbolic solution passing through easily. The dressing of carbolic lint and salicylic wadding continued.

*Oct. 1st.*—Pulse 144; small and weak. Highest temp.  $39.2^{\circ}$ . Very restless and screams frequently; gnashes his teeth; vision seems to be extinct. Ordered bromide of potassium 1.0 grms.

*Oct. 2d.*—Vomited frequently; both pupils dilated, but the left somewhat more than the right; nystagmus toward the left. On being pricked with a needle on his left side, the reflex motion was rapid, but on the right side slow. The right side seems to be generally paretic.

*Oct. 3d.\**—Comatose. Pulse 120, temp.  $37^{\circ}$ ; evening,  $38^{\circ}$ . Face red; pupils oscillating. The contraction of the left arm passed off, and he could move it again, but only slightly. Ordered wine and black coffee, but as swallowing was very difficult he was nourished per rectum, but food was not well retained.

*Oct. 4th.*—Cheyne-Stokes' respiration. Pulse, 160; temp.,  $39.2^{\circ}$ ; with the exception of which he was in the same condition as before. Ordered subcutaneous injections of quinium sulphate. Passage produced by enema.

*Oct. 5th.*—Pulse, 160; temp.,  $38.6^{\circ}$ ; deep stupor; urine evacuated by using catheter.

*Oct. 6th.*—Pulse, 192, temp.  $38.9^{\circ}$ ; evening,  $37.6^{\circ}$ ; respiration varying. Mucous râles. Subcutaneous injections of quinine.

*Oct. 7th.*—Pulse, 180, temp.,  $39.8^{\circ}$ ; cyanosis; evening, pulse, 184, temp.,  $39^{\circ}$ ; injections of quinine repeated; at 2 o'clock at night, death.

The *post-mortem* was made at 2 o'clock the next day, by Prof. J. Arnold. We were of opinion during the last weeks of treatment that the brain affection was not in direct connection with the

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\* Up to Oct. 3d he was treated by Prof. Lossen and myself, and later by us in connection with Prof. Moos.



lesion in the mastoid but was more probably tubercular basilar meningitis, which proved to be the case in the examination. Since the results of the *post-mortem* are interesting in many points we give the record unabridged :

Slight rigor. Epidermic surface of the skin white, subcutaneous adipose tissue scant, muscle system moderately developed, but of a light-red color. The skeleton was slender, but showed no decisive evidence of rachitis. Skull thick and compact ; sutures normal.

The dura thick and adherent at the convexity and basis over the points of the temporal bones. The pia of the hemispheres of the cerebrum slightly but diffusely cloudy, especially along the sinus longitud. Vessels strongly injected.

At the basis, the pia and arachnoid are dull and infiltrated with a yellowish purulent substance, and studded with numerous small white nodules. Both lateral ventricles considerably enlarged and filled with a slightly turbid serum. Ependyma moist, but not otherwise abnormal. The substance of the cerebrum and cerebellum soft, and injected with blood (especially the cortical portions), but besides showed no further change. Transparent serum in the cavities of the heart ; the pericardium normal, as also the endocardium and valves on both sides ; fluid blood and some coagula in the ventricles ; muscles of both ventricles of usual thickness, pale, but of normal consistency. The left pleural cavity contains turbid fluid. Both pleuræ of the left side show isolated miliary tubercles, and besides, that of the inferior lobe was uniformly opaque. The tissue of the superior lobe contains air, is moist, congested, and studded with miliary tubercles. At the anterior surface is a cheesy tubercle, the size of a cherry-stone. Accumulation of thick phlegm in the bronchial tubes, the mucous membrane being intensely red. The inferior lobe is more congested, softer, and contains less air, with the same changes in its tissue as in the superior. The same for the bronchial tubes. Bronchial glands enlarged and undergoing cheesy degeneration.

The right lung adherent over a great extent ; and the pleural covering intensely red and thickened, containing miliary tubercles, especially that of the inferior lobes. Tissue the same as on the left side.

Spleen adherent to the diaphragm, with miliary tubercles in its pseudo-membrane, capsule and parenchyma.



Left kidney small ; capsule adherent ; small cysts on its surface, and nodules in its tissue.

Right kidney enlarged, showing no shrinking on its surface, but otherwise in the same condition.

The mesenteric glands enlarged, and studded with small cheesy patches and nodules.

Liver enlarged and attached to the peritoneum by a pseudo-membrane, in which there are small nodules as well as in the capsule.

*Anatomical diagnosis.*—Tubercular basilar meningitis following caries of the left temporal bone. Cheesy degeneration of the lymphatic glands ; miliary tuberculosis of the lungs, spleen, kidneys, liver, and serous membranes.

*Condition of the left temporal bone.*—Immediately behind the auricle, and about 4 mm. above the canal, we find the wound in the mastoid, which has become smaller by the formation of a membranous covering on its walls. The horizontal diameter of the entrance is 1 cm., the vertical 0.7 cm., whereas, somewhat deeper, the dimensions of the cavity which communicates with the middle ear are larger, on account of a small movable sequestrum which came away. The cavity showed nothing abnormal, and there was no scar to be found at the place where the abscess broke in May as recorded above. The drum-head completely destroyed ; the mucous membrane of the tympanum, and also its continuation into the mastoid cavity were thick and infiltrated with pus. The tympanic orifice and the bony wall of the Eustachian tube were broad, and covered with a yellowish muco-purulent deposit. The head and a part of the handle of the malleus preserved ; also the body of the incus was to be seen, while the crura were destroyed. The stapes remained in foramen ovale. The tubular communication with the mastoid cavity was irregular, and slightly bent, running parallel to the external canal. Its opening (already described) lay in a higher plane than the rest. The whole antrum mast. seemed to have been transformed into this opening. Nevertheless, the communication with the external canal was narrower than we would expect, on account of the smallness of the tympanic cavity and the thickness of its mucous membrane. Thus we see that the passage of fluids would entirely depend upon the condition of the mucous membrane, even where there has been an extensive trepanation.

The external surface of the bone was normal. *A direct trans-*

*mission of the morbid process to the brain could not be discovered in any part of the pyramid or of the dura mater in its vicinity.*

*Remarks.*

A glance at the history of the case will show that our suspicions of basilar meningitis were substantiated; but it was impossible to make this diagnosis in the beginning, since six days had elapsed before the case came under our observation. For instance, we could not determine whether the initial stage of fever was ushered in by chills, much less find out whether or not the temperature was high at the start, both of which being of great importance in making a differential diagnosis of encephalic processes of Colpitis cerebialis, and diffuse meningitis (Wreden).\*

The first thermometrical examination excludes the possibility of the convexity-meningitis, since in this disease we have a continuous stage of fever with high temperature; and also phlebitis of the sinuses had to be excluded on account of the absence of chills and great variations in temperature. The accompanying curve shows that the increase was not great, nor were the oscillations in the same day. It also shows that at times there was even no fever, which, according to Wunderlich, is often observed in granular basilar meningitis. Since the temperature and the pulse increased together during the last days of the patient, and even the former went higher than the latter (not lower than is the rule), we can possibly conclude that the complication of miliary tuberculosis in the lungs and abdominal organs only made its appearance in the later stages of the disease. There is also a very rare relation of temperature, which, if it be substantiated by further observation, will be of great importance in differential diagnosis, viz.: the curve shows that, from the first to the fourth day (reckoned from the day of operation), and also on the sixth and eighth days, the temperature, which was measured at two o'clock in the afternoon, was higher than it was in the morning or evening.

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\* Compare ARCHIV. OPHTHAL. AND OTOL., iv, p. 52, and v, p. 75. Sudden and rapid elevations to high temperatures, without chills, according to Wreden, are diagnostic of encephalic diseases.

Since I have noticed these variations from the usual evening exacerbations, with more or less regularity, it may be that by carefully observing the temperature in the initial stages we may gain some important points in the diagnosis of "granular basilar meningitis."

Notwithstanding the fact that observations in the beginning of the disease are wanting, on account of the low temperature we could have been led to suspect the formation of an abscess in the brain, had not other symptoms led to the diagnosis of basilar meningitis.

The slowness and a rhythmical beat of the pulse pointed to an increase in the intracranial pressure; toward the end, however, the irregular and constantly-increasing pulse showed the characteristics of hydrocephalus in children, viz., the frequent and rapid changes in the number of beats. The change in the color of the face, which was sometimes observed only on one side, was evidently the result of irritation of the sympathetic system.

The disturbance of motility was confined to one group of muscles of the upper extremity, demonstrating itself by twitching in the flexors; but at a later stage these muscles were more paretic, and those of the other side also began to be affected. Besides these, clonic contractions of the muscles of the eyes were noticed, and the same in the pterygoid muscles, producing the gnashing of the teeth, symptoms so frequent in hydrocephalus in children.

The first-mentioned condition of the right extremity was probably brought about by hyperæmia and serous effusion into the cortical substance of the brain, and especially in the superior two-thirds of the left anterior central convolution (H. de Boyer).

This supposition is supported by the affection of several groups of muscles, the transient condition of the tonic spasms, the convulsions and the paresis, and lastly, by the absence of any lesion in the large cerebral ganglia and the capsule, from which the disturbance of motility might have resulted. Except his headache, we could not make out any sensitive disturbance, since the early appearance of coma made such observations impossible.

Of the organs of special sense, the eye was the most affected, and probably by a transmission of inflammatory processes within the sheaths of the optic nerve, and during the last four days the boy was undoubtedly blind. The dilatation of the pupils before disturbance of vision set in, and the irregularity in their sizes at a later stage are hardly to be explained, as it is not probable that there could have been an alternate paresis and irritation of the oculomotory and sympathetic; but the symptom of oscillations of the pupils, which is so often observed in hydrocephalus in children, was well marked.

As regards the other organs of special sense, the functions of the ear, at least on the right side, seemed to have been preserved until the beginning of coma. A comparison between the conditions of the two ears was impossible, on account of the refractory conduct of the patient. The sense of taste remained unchanged for a long time, and the body reacted energetically to all the medicines administered.

The organs of respiration showed no anomaly during the first weeks of the disease, except an occasional fit of coughing and vomiting which was looked upon as whooping cough. The frequency of respiration only set in during the last days, when its number amounted to 30-40 per minute, but, similar to the beat of the pulse, was liable to a rapid and frequent change. Two days before death the respiratory sounds at the base of the lungs were very weak, without any dulness on percussion; but in the superior portion there were moist râles, a condition which seems to indicate that the tuberculosis had appeared in the lungs and pleuræ only in the last days. The increase in respiration can be attributed to the miliary eruption, whereas the frequent change and arhythmic condition are pathognomonic of tubercular basilar meningitis in children.

The digestive organs showed their usual complications in brain troubles, viz.: loss of appetite, vomiting and constipation; and the ravenous appetite, which lasted only a short time, can be attributed to irritation of the vagus. The tongue and lips were both moist, at least so long as the sensorium was free. The absence of the boat-shaped belly is

against the diagnosis of acute hydrocephalus, but it is possible that this symptom is often wanting. Nevertheless, the fact that the belly remained soft and insensitive to pressure, is further proof that the miliary tuberculosis in the abdominal organs was also of late appearance.

As is frequently the case in private practice, we could not get pure specimens of urine for examination in the earlier part of the disease, and later it was passed in bed, and that which was drawn off by means of the catheter, was dark, had a heavy sediment, but contained no albumen. The enuresis, as well as the final incontinence of urine, were not sufficient to designate a definite lesion of the kidneys.

As far as the therapeutics of the case are concerned, it need hardly be mentioned that the operation would not have been undertaken, had we been able to make an early diagnosis of basilar meningitis independent of the disease in the temporal bone, but under the conviction that there was a retention of pus within the mastoid cavity, and with the hope that it was still possible to check the progress of the disease toward the brain, we considered the trepanation of the mastoid as absolutely necessary, and we believe that in all such cases the same course of treatment is indicated; nevertheless, we see again, in this case, how many unhappy complications are liable to occur in the opening of the mastoid antrum.

Again, we may ask whether the tuberculosis was the result of infection from the mastoid disease,\* and if an early operation, that is, as soon as a narrowing of the fistulous opening could be determined, or before the brain had been complicated, could have saved the life of the patient. Supporters of an early trepanation will certainly take this view, but, on the other hand, it is impossible to say that other caseous nodules, such as the enormously enlarged and degenerated bronchial glands, had not made their appearance before the mastoid disease set in; in fact, whether the whole condition of the middle-ear affection was not caused by a tuberculous diathesis, or at least that this diathesis was an

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\* An opinion of Buhl, which is, however, denied by Colmheim, in his latest article on "Tuberculosis from the Standpoint of Infection," Leipzig, 1879.

obstacle to the cure of the ear disease after it had once commenced. The parents of the child are healthy, as also his brothers and sisters, even the boy himself is said to have been well up to the beginning of his ear trouble; but, on the other hand, we learn that the grandfather, on the father's side, although to-day a strong old man, was sick for a long time, and was looked upon as a consumptive. He had ten children; and four daughters (aunts of our patient) died of tuberculosis. We therefore see that the family is tuberculous, and it is possible that the disease of the ear, the cough and peritonitis, may have hastened the maturity of the tuberculosis, notwithstanding the fact that the boy had always lived in the country, was well nourished, and his general health apparently was as good as could be desired.

When under such favorable conditions the fistulous opening in the proc. mastoid. commences to close, the running has stopped, and there is no pain in the ear, a reasonable hope may be entertained that the disease is tending toward a cure, and the surgeon, as also the parents, will not be inclined to subject the patient to the dangers of an important operation. Indeed, such an operation is useless, if, as in our case, we do not find a cheesy retention, and, if there be already an existing dyscrasia, may be absolutely harmful, on account of the accompanying excitement, the loss of blood, and the danger of wound-fever to which it exposes the patient.



PYÆMIA FOLLOWING A MASTOID ABSCESS.  
TREATED WITHOUT MEDICINE. RE-  
COVERY.

BY EDWARD T. ELY, M.D., NEW YORK.

THE importance of clinical observations bearing upon the condition known as *pyæmia*, and the rarity of recovery when severe manifestations of that condition have appeared, are my reasons for publishing the following case:

Louis S., aged 15, has had chronic suppuration of both middle ears for many years. During the past year he has been treated in the clinic of Dr. Roosa and myself at the Manhattan Eye and Ear Hospital, and nothing unusual has been observed about his case until lately. On the afternoon of Jan. 20th he was brought to me with well-marked mastoid periostitis on the right side. The cause of this inflammation was not evident. The redness, tenderness and swelling were confined chiefly to the anterior two-thirds of the mastoid process, and the swelling was not very great. There was severe pain in that side of the head, and marked constitutional disturbance. An immediate operation was advised, but was declined by the family. The boy was taken into the hospital, however, and four leeches were applied. When seen by me at half past eight the next morning, he was decidedly worse. There was high fever—a temperature of  $104\frac{1}{2}^{\circ}$ —and great pain in the right side of the head. With the assistance of the house-surgeon, Dr. Cox, I made a Wilde's incision, but found no pus. The bone exposed by the incision seemed sound; but after considerable burrowing under the anterior flap of the wound, I detected a softened spot in the bone through which a stiff probe

was gradually worked into the mastoid cells, and a small quantity of thick pus then escaped. After the fistula had been enlarged, a tent was inserted, a poultice applied, and the hot douche ordered to be used every two hours. The operation was performed under ether. The bad symptoms were immediately relieved. At 1 P.M. the temperature was  $101\frac{1}{2}^{\circ}$ , and it fell rapidly to the normal. The mastoid tenderness and swelling subsided. The patient seemed to be making a speedy recovery, and I considered him out of danger. The wound was syringed with carbolized water and the tent changed twice a day; and the ear was douched frequently with hot water. Excepting that some pain persisted in the frontal and right temporal regions, there appeared to be a progressive improvement in all respects until Jan. 27th. Early in the morning of that day he suddenly had a chill, and the temperature at 9 A.M. was  $104\frac{1}{2}^{\circ}$ . He complained of pains in various parts of the body, especially in the left knee joint, the throat, and along the right external jugular vein. All these points were very tender, particularly the track of the vein, but there was no external redness or swelling. The discharge from the wound became less. Between this date and February 8th he presented well-marked symptoms of *pyæmia*. He had irregular chills and sweats, and a temperature varying irregularly between  $99\frac{1}{4}^{\circ}$  and  $105^{\circ}$ . His tongue at first was brown and dry, and then became very red, dry and glazed. There was great prostration, a rapid pulse, and a dusky pallor of the skin. There was marked increase of the previous deafness on both sides. He was restless at night, and may have had slight delirium, judging from the account of his friends who sat with him; but no delirium was observed by any of his medical attendants. His pupils always appeared normal. He had some cough and complained of pains in his chest but I could find nothing abnormal by physical examination. Several copious clay-colored stools occurred. His general condition was so alarming that I thought he would surely die; and this was the opinion also of Dr. Roosa, who saw him frequently in consultation with me. An unfavorable prognosis was given to the family.

Additional features of his sickness may be gathered from the following somewhat incomplete notes, which I made from time to time:

*January 28th.*—Pains the same as yesterday. Pains also in right axilla, along the inner edge of the right biceps muscle and in the right knee. All these points very tender.

*January 29th.*—Discharge from the wound more abundant, of dark-brown color, and fetid. [This continued for five days.] Pains the same.

*January 31st.*—Pains and tenderness along each clavicle. A red and tender swelling about the size of a walnut has appeared over the left sterno-clavicular articulation; distinct sense of fluctuation.

*February 2d.*—Pains and tenderness along clavicles, shoulders and arms. Less tenderness along jugular vein.

*February 5th.*—Red and painful swellings, apparently glandular, in the neck, below mastoid, right side. [Deep suppuration occurred in the tissues of the neck subsequently, and the pus was evacuated through the mastoid opening.]

*February 12th.*—Swelling over clavicle gone. [All who examined this swelling had diagnosticated fluid contents, but no incision was made into it.] Opened an abscess in the gum over the second molar tooth, right upper jaw, and evacuated considerable pus. The whole right side of the face was flushed, swollen and tender. A probe in the incision passed about  $1\frac{1}{2}$  inches upward over the exterior of the bone. Patient sits up for the first time.

There were no unfavorable symptoms after this date. The convalescence was slow, and the patient was not strong enough to leave his room until February 20th. He went out February 26th. At that time there was a free discharge from the mastoid fistula and from the ear, and the hearing was  $\frac{c}{40}$ .

Below is a partial record of the temperature :

*January 21st.*—9 A.M.,  $104\frac{1}{2}^{\circ}$ ; 1 P.M.,  $101\frac{1}{2}^{\circ}$ ; 7 P.M.,  $101\frac{1}{2}^{\circ}$ .

“ 22d.—9 A.M.,  $101^{\circ}$ ; 7 P.M.,  $101^{\circ}$ .

“ 23d.—9 A.M.,  $100^{\circ}$ ; 7 P.M.,  $99\frac{1}{2}^{\circ}$ .

“ 24th.—9 A.M.,  $99^{\circ}$ ; 7 P.M.,  $99^{\circ}$ .

“ 25th.—9 A.M.,  $98\frac{1}{2}^{\circ}$ ; 7 P.M.,  $98\frac{1}{2}^{\circ}$ .

“ 26th.—9 A.M.,  $99^{\circ}$ ; 7 P.M.,  $98\frac{1}{2}^{\circ}$ .

“ 27th.—9 A.M.,  $104\frac{1}{2}^{\circ}$ ; 7 P.M.,  $101\frac{1}{2}^{\circ}$ .

“ 28th.—9 A.M.,  $104^{\circ}$ ; 12 noon,  $104\frac{1}{2}^{\circ}$ ; 7 P.M.,  $103\frac{1}{2}^{\circ}$ .

“ 29th.—9 A.M.,  $104\frac{1}{2}^{\circ}$ ; 12 noon,  $105^{\circ}$ ; 10 P.M.,  $103\frac{3}{4}^{\circ}$ .

“ 30th.—9 A.M.,  $100\frac{1}{4}^{\circ}$ ; 2 P.M.,  $103^{\circ}$ .

“ 31st.—9 A.M.,  $100^{\circ}$ ; 10 P.M.,  $99\frac{1}{2}^{\circ}$ .

*From February 1st to February 8th.*—The temperature varied between  $99^{\circ}$  and  $101^{\circ}$ .

This case is interesting not only on account of its fortunate termination, but because it serves to illustrate the nat-

ural course of the disease in question ; for, throughout his illness, the patient took no drugs whatever. This plan of treatment was adopted at the outset from my conviction that no drug would arrest the septic poisoning, and that the large doses of quinine often used were capable of doing harm. This view was shared by Dr. Roosa in all my interviews with him ; but it evidently excited wonder in the minds of some of the medical visitors who happened to be attending the clinics at the time. This very common feeling of surprise at seeing any alarming sickness treated without the use of what is by so many considered essential, shows that many minds can profit by the study of just such a narrative as has been given above.

Aside from the matter of drugs, this boy, of course, had a great deal of medical treatment, in the best sense of the words. He had a quiet room to himself with an open fire ; some member of his family sat with him each night, and he had the efficient nursing made possible through the kind supervision of Dr. Cox, as well as the latter's constant medical observation. I visited him often myself, and every small detail regarding food, stimulants, dressings, etc., received thoughtful consideration. Fortunately, food was well borne during the entire period. The diet consisted of milk, to which was added a little sherry wine at first, and afterward a little whiskey. Poultices were kept applied over the jugular vein and upon the painful swelling over the left sterno-clavicular joint. The free action of the bowels was doubtless useful in eliminating the poison, as has been remarked of other similar cases. Might not large doses of quinine (through their astringent action) have tended to check these desirable movements of the bowels, in addition to the depressing effect they might have had upon the nervous system ?

As soon as the crisis of this boy's illness had passed, the improvement in the expression of his face and in his whole aspect was so striking, that it would naturally have been attributed to any medicine that he might have been taking at the time. Still more natural would such an inference have been regarding the rapid disappearance of the abscess—for such I believe it was—over the clavicle.

Another interesting point is that the sanitary condition of our hospital is considered unusually bad just at present.

I would not have these remarks understood as an argument that pyæmia is better treated without drugs, or that, by withholding drugs, a life has here been saved. There is, of course, no proof that this patient's recovery was due to anything that we did for him, although I cannot help feeling that his chances were improved by his hospital care. His history is made public in the hope that it may prove instructive as well as interesting to some who may read it.

## ON A PECULIAR EXOSTOSIS IN THE EAR.

BY A. HEDINGER, M.D., OF STUTTGART.

Translated by ISIDOR FURST, of New York.

(*With plate ii, figs. 1-3.*)

THE chapter of the exostoses is still rather dark. Their pathogenesis is as yet entirely unknown, and scarcely rises above the level of hypotheses. I intend, therefore, to present in the following pages a picture differing from the ordinary exostosis, because the microscopic examination of the parts removed by operation offered surprising information regarding their origin, prognosis and treatment.

In respect to the etiology in general, I must, with almost absolute certainty, in about 40 cases which I have observed in the last few years, exclude syphilis which is given by Toynbee and v. Tröltsch as a prevalent cause, and also the abuse of alcoholic liquors. I rather incline to the view of the younger Delstanche who, in his "Contribution à l'étude des tumeurs osseuses du conduit auditif externe," finds the cause in a chronic inflammation of the walls of the external auditory meatus, which is either isolated or combined with similar affections of the middle ear. I can also concur with him in this, that frequently some other disease of the organ of hearing accompanies the new-formation, such as chronic tubal catarrh or suppuration. In the case to be detailed now, it is evident that the tumor was a consecutive one, and arose in the course of an inflammation of the mucous membranes of the middle ear.



The patient, a switchman, otherwise healthy and formerly with good hearing, had suffered for the past eighteen months from otorrhœa on the right side, without known cause, until violent pain now forced him to consult a physician. The latter found diffuse swelling of the parts around the ear, and a moderate rise in temperature. The hearing was almost gone, as was bone-conduction. In the right meatus he found a new-formation which the patient stated had arisen since the suppuration commenced; it occluded the meatus completely, was immovable, and of bony hardness to the probe. No pus, no fluctuation anywhere, rather high fever. In the succeeding few days the condition remained stationary. Two weeks later, however, on pressure upon the portion of the ear-canal adjoining the new-formation inferiorly, two tablespoonfuls of thick, creamy pus were evacuated, and during the succeeding probing it appeared to the physician as if he were encountering rough bone at the lower surface of the tumor. The next few days, there was a remission of the fever and great subjective relief, especially when pus was evacuated by pressure.

The treatment consisted in irrigations with carbolic acid and painting with tincture of iodine.

Soon after this the patient came under my treatment. The first thing that struck me was the great injection and swelling of the mastoid process and its surroundings, as well as the pathognomonic forward and outward displacement of the auricle; no fluctuation could be recognized on pressure. The meatus was filled with a hemispherical, immovable new-formation of osseous consistence, starting from the upper and posterior wall of the auditory meatus (comp. the illustration, plate ii, fig. 2, *A*). Below and between it and the anterior wall, the probe could be inserted to the depth of 2 *cm.*, where some rough bone was felt. At the same time, there was a copious evacuation of pus which increased still more on pressure upon the auricle. Very annoying and painful tension of the skin. Hearing distance and bone-conduction = 0, tube free, with loud perforation whistle and rattling.

The treatment consisted in irrigations, twice daily, of potassium hypermanganate, and application of cataplasms behind the ear. After a few days, I made a very long Wilde's incision, and evacuated at the same time several tablespoonfuls of thick, healthy pus. The probe could be inserted deeply in the new

opening inward and above in the direction of the external auditory meatus. The water used in the dressing also flowed in the same direction, as soon as it emerged from a fistulous tract extending from the floor of the meatus obliquely toward the retromaxillary fossa, where it opened. The tumor at the mastoid process collapsed rapidly. In order to obtain an idea of its hardness, a test puncture was then made with the electrolytic needle. The needle entered with some difficulty. But before I decided upon an operative procedure, I made another attempt with laminaria which had a surprising effect. It was evident, indeed, that by a daily introduction of laminaria the swelling became visibly smaller and was crowded toward the posterior and upper walls of the auditory meatus, while the lumen of the external ear-canal grew wider and wider. A single intermission of the introduction of the laminaria\* was followed by an immediate enlargement of the neoplasm as early as the next day. Once a square-shaped necrosed piece, 8 mm. by 4 mm., was withdrawn from the lower wall of the auditory meatus. With the renewed employment of the laminaria the ear-canal again widened considerably, apparently exceeding its normal calibre. Its covering assumed the appearance of a tissue in a state of callous degeneration, together with granulations secreting pus abundantly. The same tissue also formed the background of the meatus.

The membrana tympani was entirely degenerated, or rather, had a large defect in consequence of the ulceration. At the lower wall of the meatus several fistulous openings could be demonstrated from which the water injected through the incision welled up in a body. At the place where the neoplasm adhered to the meatus, *i. e.*, at the upper wall, the probe discovered a slight depression in the bone, filled with caseous pus.

After the cessation of the stagnation of pus, an operation was not essential; besides, I desired to await the further effect of the laminaria, which, of course, had its limit. I therefore did not divide the cords bordering on the anterior fistulous tract until I saw that it was of no further use. I then applied the chisel to the before-mentioned depression, in order to enlarge it. In this way I laid bare a cavity the size of the antrum mastoideum, but I abstained from a further enlargement of the opening, as it contained no noteworthy quantity of pus. But I applied the chisel to the lower third of the tumor, and removed numerous particles

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\* He prepared the laminaria-tents himself from the root of the plant.

in this manner, amounting in all to about a piece the size of a pea. A dense fibrous tissue closely enveloped the osseous nucleus and was connected with its surroundings by cords. The chiselling was easy, and I should have looked upon a galvanocaustic operation, in this case, as decidedly unjustified. There was no inflammatory reaction, and therefore several other smaller pieces were removed on the following days from the place of the first operation. Now that the pus, which, as was clearly shown, issued from the drum-cavity, had free egress, the question arose, whether the tumor should be completely removed in the above-described manner, and whether it should be done at once. As I expected to obtain information in several respects from the microscopic examination, and as haste was not indicated, several preparations were made from the removed mass, as follows :

*A section through the periphery* (see plate ii). The papillæ are proliferating, of different lengths, and divided in many ways, and epithelial cones are between them. At the periphery they approach the normal. Toward the centre, however, bone-substance may be seen in the shape of osteoid tissue, that is to say, the new-formation of bone at that place does not proceed in connection with other bones, but as ossification of the connective tissue in isolated patches; the calcification extends high up on the papillary body.

*A second section* (see plate ii), under low magnifying power, shows a strange proliferation of the cells in the tissue of the cutis, besides the enlargement of the papillæ. The cells represent the final products of an inflammatory irritation of the connective tissue, *i. e.*, a large increase of connective-tissue corpuscles. Under high power, and after staining with hæmatoxylin, we also observe pus cells in the epithelium, and an effusion of blood under a vesicular detachment of the epidermis. The same condition is shown by sections of the exostosis decalcified by chromic acid. Therefore, the diagnosis is made of *inflammatory proliferation of the papillæ and of the connective tissue, with deposition of lime within it (osteoid metamorphosis)*.

As there was present no new-formation of bone, such as is generally observed in exostoses, but rather an inflammatory

process which, of course, was combined with osteoid metamorphosis of the proliferating connective tissue, thereby acquiring the character of a true exostosis, I had to ask myself the question whether the complete removal of the neoplasm was of value at the present moment; whether the transformation of the connective tissue was not rather continually renewed as long as inflammatory symptoms, which possibly might extend toward the brain, were present. I therefore decided to wait, and simply ordered astringents, together with oft-repeated cleansing with salicylated water and continued insertion of laminaria.

Gradually the fistulous tracts closed, and the suppuration became less. Despite all this, however, new granulations sprang from the wound of operation; they were only less firm to the touch. The defect at the mastoid antrum closed completely.

At this time the patient, who had been under treatment about six weeks, was obliged to resume his duties, and I could not re-examine him until after some weeks—a period I awaited with great interest, as I thought to be able to determine the necessity of a further operation from the condition of the new granulations. If they still seemed to consist to the naked eye of succulent connective tissue, I thought it would be better to undertake the final removal of the tumor after the disappearance of all inflammatory symptoms, in case the patient still insisted upon it; because, in the absence of bone-conduction and of any hearing power, I was forced to assume an obliteration of the middle and inner ears—a condition which, fortunately for the patient, was not substantiated later.

To this end I removed many granulations and particles of bone with the sharp spoon. The probe could be inserted to the depth of 4 *cm.* Granulations were present throughout the auditory meatus, with slight suppuration. The new formation had not enlarged. The proliferations at its lower surface were quite distinct from the harder tissue situated more deeply. At its posterior aspect rough bone could be felt.

The microscopic examination of the removed masses showed pretty nearly the same tissue, only the cell proliferation in the cutis was less copious. The new-formed osteoid tissue was likewise present in smaller quantity than at first. I could, therefore, conclude that the inflammatory process was abating. A like condition,

but increased in degree, was observed several months later, after the same treatment as before (laminaria and salicylic acid). The suppuration diminished steadily ; the walls of the meatus, formerly covered with granulations, became invested with normal tissue. The membrana tympani, in the place of which only ulcerating tissue could formerly be seen, again became visible, having a paler color ; an oval perforation was in its lower portion close to the meatus. Bone-conduction was restored. Hearing distance for a watch with a pitch and an intensity of Politzer's acoumeter, 5 *cm*. New-formation stationary. After two months more, the suppuration had disappeared. From that time I did not see the patient for six months, during which time he was engaged as a switchman at a rather elevated station (about 400 metres), without any disturbance in his condition during the past severe winter, and without applying anything. When he again presented himself, some weeks ago, the following condition was noted :

No suppuration. The surface of the tumor was covered with a smooth, pale membrane ; it still filled half the lumen of the meatus ; behind it the coverings appeared normal and were limited by the smooth, glistening, cicatricially regenerated membrana tympani with a concave opening in the lower part, almost the size of a pea, through which the mucous membrane of the promontory, showing the same color and condition, could be clearly recognized. See plate ii, fig. 2, *B*.

Bone-conduction distinct, though not as yet of normal strength. Hearing distance 30 *cm*.

Thus the question which I had originally asked myself, whether a complete removal of the tumor was indicated, had been answered in the negative, because after removal of a portion of it, there ensued a cessation of the inflammatory symptoms (suppuration, etc.) which had been increased by the occlusion of the ear-canal. From that time the tumor remained stationary, no longer hindering the patient in the discharge of his duties. He was well satisfied with the result. By careless removal of the entire neoplasm, an unnecessary danger would have been incurred—that of extension of the inflammation to the mastoid process and the meninges. At present a removal of the remainder of the tumor—which, by-the-by, the patient himself does not desire—would not be justifiable.

It would only be indicated if the tumor should grow, of which, however, there are no symptoms present. By the aid of the microscope, inflammation was demonstrated as the pathogenesis of a neoplasm, and accordingly furnished a clue to the treatment to be instituted. The effect of laminaria upon such a comparatively large and firm tumor is at any rate not without interest and but rarely recorded in literature.



## ANATOMO-PATHOLOGICAL CONDITIONS IN A CASE OF MALFORMATION OF THE RIGHT EAR.

BY S. MOOS AND H. STEINBRÜGGE, OF HEIDELBERG.

Translated by ISIDOR FURST, of New York.

WE are indebted to Dr. Emil Bloch, of Graben, for the opportunity to make the following examination, and for the history appended.

On the 11th of May of this year, the married couple F. H. showed me their first-born child Louisa, two days old, on account of a defective development of the right auricle. The parents are healthy and well formed throughout.

The right auricle, indeed, was misshapen in a high degree; only the lobule could be distinguished with some accuracy, while the upper half of the pinna was folded over the lower one, so that the whole, at some distance, bore some resemblance to a cauliflower excrescence. On attempting to expand the parts with the fingers, the cartilage, by its elasticity, immediately returned to its former position. No trace could be discovered of the external auditory meatus; one or two quite shallow depressions took the place of the furrows and grooves of the normal auricle.

Moreover, this rudimentary piece did not occupy its ordinary position, but was situated more to the front and below, upon the ascending ramus of the inferior maxilla; the latter, and indeed the entire right half of the lower jaw, was less strongly developed than on the left, being narrower, less prominent, the arch shallower, so that the lower half of the right cheek, as compared with the left, was considerably flatter, and the child's face exhibited a peculiar distortion. The vault of the cranium showed no abnormal formation.

On May 17th, general convulsions with cyanosis occurred, to which the child succumbed on the 20th, the eleventh day of her life.

The rudimentary right auricle, when expanded, measured in length 1.8 *cm*.

The left, normal one, 3.5 *cm*.

The right inferior maxilla, from the middle of the chin to the angle, 4.5 *cm*.

The left, normal one, 6.5 *cm*.

Besides, the symphysis of the inferior maxilla was displaced to the right rather more than half a centimetre.

The distance from the septum narium to the condyle of the lower jaw measured, *Right*, 6.3 *cm*, *Left*, 8.0 *cm*.

I was unable to find a trace of the external auditory meatus in the soft parts; the condition of the Eustachian tubes was not examined.

The cerebral meninges were very full of blood. The œdematous brain *dissolved* when taken from the skull. At the base of the skull I could see no abnormality, in particular no difference between the right and left temporal pyramids.

For fear of spoiling the specimen, I did not dare to investigate whether there was any malformation in the deeper parts of the ear.

The case vividly recalls the one of "Asyntrophy of the right Temporal Bone," reported by G. Brown.\* There, too, the auricle was defective, the lower maxilla unsymmetrically developed, and the cheek flattened. Only, in the present case, I am unable to refer the malformation to the temporal bone and the faulty position of the glenoid fossa. They might rather, in this instance, be referred, as by Virchow,† to early disturbances in the growth and development of the first branchial fissure and the first branchial arch, from which latter, besides the lower jaw, the malleus and incus are also formed. Inasmuch as in my case we have to deal with a faulty development of the right lower jaw, a like state might also prevail with the two ossicles named. I therefore take the liberty of forwarding to the editors, together with these memoranda,

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\* These ARCHIVES, vol. ix, No. 2, pp. 168 and 169.

† *Virch. Arch.*, Bd. xxx, p. 222.

the excised right temporal pyramid preserved in spirit of wine for further examination.

*Condition of the Petrous Bone.*

The petroso-squamous fissure is 1 *cm.* long ; the jugular fossa is club-shaped, very shallow ; its broadest part measures 3 *mm.*, its narrowest part 1½ *mm.* The carotic canal, where it enters the petrous bone, has a diameter of 2 *mm.* ; at its apex, and in the middle of the canal, 4 *mm.* The styloid process and the cartilage of the Eustachian tube are absent. The canalis facialis, together with the stylo-mastoid foramen, shows an osseous obliteration up to a distance of some millimetres peripherally from the hiatus canalis Fallopii. In the region of the stylo-mastoid foramen there is a small triangular piece of cartilage, probably an indication of the styloid process.

The external auditory canal, excepting a small triangular space, is obliterated. The base of this space, directed backward, is 1 *mm.* long, the sides, ½ *mm.* An osseous bridge, 2 *mm.* broad, separates the space just described from a cavity about twice that size, situated in the region of the drum, likewise of a triangular configuration with the base behind and above, and the point in front and below. At the medial wall of this small space are the two labyrinthine fenestræ,—a small opening of the diameter of thin metal wire which can be passed through it into the first cochlear convolution ; and another one situated behind and above the former, roundish, much larger, and free, through which the vestibule is reached. In front of the just-described space of the drum cavity, at a distance of 5 *mm.* and immediately adjoining the lower wall of the carotic canal, we found a shallow depression, barely 1 *mm.* in diameter,—probably an indication of the completely obliterated osseous Eustachian canal. It was lined with connective tissue and elastic fibres, in the meshes of which were large round and oval cells with similarly shaped small nuclei which took a bright carmine stain.

In the posterior portion of the middle ear, separated from the above-described drum-cavity by a sclerotic mass of bone, 2 *mm.* broad, was found another hollow space of approximately oval form, measuring 7 *mm.* in the longitudinal, and 2½ *mm.* in the transverse diameter, which was filled with a tissue of the same structure as that described in the supposed rudiment of the Eustachian tube. At the extreme limit of this space, anteriorly and above, was the stapedius muscle.

There were absent, therefore, the membrana tympani, the annulus, all the ossicles including the plate of the stapes, the tensor tympani, the nerve-plexus of the drum-cavity. An indication of the petrous fossa was present at the inferior surface of the petrous bone; the canaliculus tympanicus, however, was obliterated.

We found the entire osseous and membranous labyrinths normally developed, excepting the communication between vestibule and cochlea, which we could not demonstrate in spite of repeated endeavors. We shall only briefly state the normal condition of the acoustic nerve at its bifurcation into a ramus cochleæ and vestibuli, the normal state of the several cochlear convolutions, of the membranous formations of the semicircular canals and the vestibule on microscopic examination. We have already stated that the facial nerve could be followed only as far as the hiatus canalis Fallopii.\* The nervous petrosus superficialis major was present; the ganglion geniculi was absent.

#### *Remarks.*

From what has been stated, it appears that the case was one of arrested development in the region of the first branchial arch. That such a state may be excluded in the region of the second branchial arch is probable by the existence of a cartilaginous nucleus in the styloid process (Politzer), as well as by the existence of the stapedius muscle. According to Reichert, the portion of the second branchial arch which does not change into cartilage becomes the stapedius muscle; it is followed by a longer piece of cartilage which coalesces with the pars mastoidea of the primordial skull, which, if it ossifies, forms the papillary eminence on the posterior wall of the drum-cavity, and the styloid process. The described position of the stapedius muscle is not surprising, at least regarding its distance from the partially obliterated drum-cavity; for "the auditory ossicles at first are placed above and behind the drum-cavity, and, only subsequently they apparently become

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\*At least in a peripheric direction we could find nothing further of the nerve. On inquiring of Dr. Bloch in regard to a possibly present paralysis of the facial nerve, we received the following reply: "Neither I nor the parents of the child, whom I specially asked to-day about it, have noticed symptoms of right-sided facial paralysis. The child made a normal use of its facial muscles during crying and nursing, as far as we can remember at this date."

situated in the drum-cavity—a remark equally true of the chorda tympani, the stapedius, and the ligaments of the ossicles.”\*

The disturbance of development probably was caused by an early irritative process which led to an *abnormal osseous new-formation*; for all the missing parts were entirely, and the air-spaces partially, replaced or obliterated by a dense mass of bone. As the malleus and incus, “at first entirely cartilaginous, commence to ossify in the fourth month of life,”† the irritative process must have occurred at an earlier period.

Although it is well known that the labyrinth develops independently of the middle and external ears, we may yet especially emphasize the normal state of its osseous and membranous parts. The above-described anomaly of the two labyrinthine fenestræ is not at all surprising, being the obvious consequence of the osseous new-formation in the middle ear; nor is the absence of the stapes which, at any rate, as demonstrated by recent investigations, develops, not from the second branchial arch, but independently from the walls of the labyrinth.

In many respects the case resembles one reported by Moos in the ARCHIVES OF OPHTHALMOLOGY AND OTOL-  
OGY, vol. ii, No. 1, p. 139. In that, likewise, the disturbance was in the region of the first branchial arch, for the membrana tympani, malleus and incus were absent. The drum-cavity, including the passage to the fenestra rotunda, and the latter itself, were obliterated by bone, leaving only a small cavity beside and below the region of the stapes. The osseous tube was also narrowed to an opening the size of the point of a pin; but the styloid process—the case was that of an adult—was complete, and the stapes, although somewhat defective, was present, as was the external meatus. In this case, too, the labyrinth was normally developed, while there was a defective development in the labyrinth of the left side. The entire inner ear, namely, was obliterated; the semicircular canals, vestibule

\*Kœlliker: *Entwicklungsgeschichte des Menschen*, etc., 2d ed., p. 746.

† Kœlliker, *l.c.*, p. 472.

and cochlea, as well as the two fenestræ, were absent. Similar conditions have been described by Montain and Saissy in deaf-mutes.

It is remarkable that in this case the osseous obliteration of the auditory meatus was again found on the right side, as in most of the cases observed hitherto. The alterations described support the view that such cases should be looked upon as a *noli me tangere* in respect to operations. Assuming even that in such a case, where the labyrinth did not share in the disturbance of development, the fenestræ of the labyrinth were quite normal, it still would be a surgical impossibility to produce a passage which would permit a continuation of the vibrations of sound, through air-conduction, as far as the wall of the labyrinth. On the other hand, there can be no doubt that where the labyrinth is quite normal, in cases of osseous occlusion of the external meatus, the bone-conduction would convey sound sufficiently to protect the child from deaf-mutism. In support of this view, we may cite a case, observed by Moos, of bilateral osseous occlusion of the external auditory meatus, with unilateral malformation of the auricle, in which speech could be understood at the distance of several metres, and deaf-mutism was out of the question.\*

In this connection, the view of Toynbee is noteworthy, who states, and supports his opinion by some cases, "that in congenital malformations of the ear we may expect, as the general rule, a sufficient development of the organ for the purposes of education and the earning of a living."

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\* Silvio Escolano, in the *Monatsschrift für Ohrenh.*, No. 10, 1880, gives an abstract of a case published by A. Fernandez Palacios, a physician of Almeria, in the *Revista de Medicina y Cirugía práctica*, J. vii, No. 99.

There was an atresia of the external auditory meatus and absence of both auricles in a girl of 12, who was not well developed. "It is surprising that, despite these anomalous anatomical conditions, the functional activity of the organ of hearing is pretty well preserved; only it may be noticed that the girl, on listening, unconsciously and almost automatically opens her mouth, although she can hear—though not as plainly as otherwise,—with mouth and nostrils closed, whatever may be said in a loud or low voice. As this preservation of the auditory function speaks for the integrity of the middle ear and the labyrinth, the opinion would seem justified that an operative interference would give normal conditions to audition. Unfortunately the relatives will not permit this."

This communication cannot modify our opinion, expressed in the text, about the non-execution of the operation, because it presupposes normal conditions beyond the atresia of the external auditory meatus which are by no means demonstrated.



## THE COTTON-PELLET AS AN ARTIFICIAL DRUM-HEAD.

By H. KNAPP.

SINCE Yearsley in 1848 recommended a moist cotton-pellet, and Toynbee in 1853 a small India-rubber disc, as a means for improving the hearing of persons whose drum-heads were more or less defective, the discussion on the subject of the artificial drum-head has passed through various stages. At the present day there is still so great a divergence of opinion about the usefulness of this little contrivance, the mechanism of its action, its best form and material, its mode of action, its indications and counter-indications—to say nothing of its curative effects—that new observations do not yet appear to be out of order. The earlier authors on the subject, viz., the inventors; further, V. Trölsch, Politzer, Moos, Lucae and others, were very sanguine about its efficacy, and spoke of many or very many cases in which an artificial membrana tympani had considerably increased the acuteness of hearing. Then a period of reaction set in, in which only in exceptional cases some value was ascribed to the artificial drum-head. This period is not yet over, for, unless I am mistaken, the artificial drum-head is only rarely resorted to, or, if tried at all, laid aside after the first unsuccessful attempts. Dr. C. E. Hackley,\* of this city, says: "This little appliance does not seem so generally used as it deserves." Dr. A. H. Buck in his recent, very valuable text-book† probably ex-

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\* These ARCHIVES, viii, p. 228, 1879.

† "Diagnosis and Treatment of Ear Diseases." W. Wood & Co., New York 1880, pp. 277.

presses the present opinion of the majority of aurists—and up to a year ago it was also the opinion of the present writer—in the brief mention he makes of the subject, which is as follows: “So far as the symptom of deafness is concerned, a certain degree of relief may be obtained in a few cases by the wearing of Toynbee’s artificial drum-membrane. I have not seen more than four or five cases in which this contrivance, or some substitute for it, materially increased the acuteness of the patient’s hearing. At the same time, I must confess that my lack of faith in its efficacy has led me to test its virtues in comparatively few cases. Furthermore, the presence of such a foreign body in the meatus, and in close contact with the drum-membrane, or with the stump of the manubrium mallei, is very annoying to the great majority of patients.”

Most of the other text-books devote—I believe, deservedly—more space to this subject, and though they teem with repetitions, each author speaks of the benefit which the little device has rendered to many of his own patients.

Dr. Hackley in his above-mentioned communication says (page 229) “the best instrument that we at present have is Toynbee’s artificial membrana tympani.” This statement is flatly contradicted by Dr. C. H. Burnett, of Philadelphia, who begins his very interesting paper on “Uninterrupted Wearing of Cotton-Pellets as Artificial Drum-Heads”\* with the following words:

“There has never been but one useful kind of artificial drum-head, and that is the cotton-pellet of Yearsley.” This statement is too sweeping, for, apart from many well authenticated cases, I know that two years ago, Dr. Hackley, at my request and in my presence, used, with great and, as it seems, lasting benefit, Toynbee’s artificial drum-head in a patient whom I had treated off and on during several years for attacks of purulent and desquamative otitis media. Nevertheless, I must confess that I personally have not had much good luck with the rubber disc, but the cotton-pellet has given me great satisfaction, as the subjoined cases will show. The same experience has been made by other ob-

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\* *Am. Journ. of Otol.*, ii, p. 14, 1880.

servers, and among them I take particular pleasure in mentioning Tröltzsch, for his remarks on the artificial drum-head in the newest editions of his invaluable text-book are very clear and instructive. He says: \* “After having become acquainted with Hassenstein’s little cotton-forceps, I have almost completely abandoned the use of the artificial drum-membrane proper. A number of patients wear the cotton-plugs for years with constant relief of their deafness and material benefit as to the suppuration.” I can corroborate this statement by an example that is probably more conclusive than any one on record. A full history of the case may be of interest to our readers, as it exhibits almost all the points connected with the wearing of an artificial drum-head.

CASE I.—*Otorrhœa of seven years’ duration relieved in two months. Cotton-pellets worn with great benefit for 29 years.*

Mrs. J. W. K., æt. 41, a wealthy and cultivated lady of this city, had scarlet fever when she was five years old. Copious offensive discharge followed until she was 12 years. She grew so hard of hearing that she could understand people only when they spoke loud and directly into her ears. Dr. F. A. Cadwell then took charge of her case, and in two months considerably relieved the discharge by syringing the ears and pouring liquids in. After this he put cotton-plugs into both ears, which, on account of the discharge, had to be changed frequently for a long time. The doctor did this himself until the discharge had almost disappeared. Ever since that time, that is about 29 years, she has worn the cotton-pellets, and by their aid has always enjoyed good hearing, and has been free from pain and inflammation. Five or six years ago, when I had operated on her mother for glaucoma, she mentioned her ear difficulty to me, and allowed me to examine her ears. I found that without the pellets she understood conversation only at the distance of a few feet ; with them, at twenty.

Last week I examined her again for the sake of this communication, and learned the following : At times she changes the cotton daily, but mostly every two or three days. When she leaves it in longer, for instance a week, it becomes dry and is of no use. It is only good as long as it is moist, which is seldom longer than three or four days. She takes it out when the ears feel uncom-

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\* Text-book, 5th edition, pp. 402, 873.

fortable, or when discharge is noticeable, or the hearing bad. After the removal of the pellet, she pours a few drops of warm water into the ear, lets it in for about five minutes, and then dries the ear with absorbent cotton wound around a dentist's cotton-holder. Syringing the ear is apt to make her dizzy, and the water runs into her throat. When she leaves the cotton out for several days, the discharge at once diminishes, and soon the ears dry up. When she then inserts the cotton-pellets again, she hears very well, better than before. She removes the cotton and puts a new piece in with a delicate pair of forceps. She shapes it into a thin disc, like a wafer, about a centimetre in diameter, soaks it with pure glycerine, seizes it with the forceps in the centre, and pushes it into the ear as deep as she can. If the hearing is not at once improved, she does not make many attempts at adjusting the pellet, but prefers to take it out and put a new one in. Sometimes the ears immediately after the insertion feel plugged tight, and the hearing is bad, then by blowing her nose, or from itself, a bubble seems to burst with a snap, upon which the stopped feeling disappears, and she hears well again. A minute after she has inserted the pellet, a watery discharge runs from her ears for several hours. Supposing that the pure glycerine caused this abundant secretion, of which my other patients who use 1 part of glycerine to 3 parts of water have not complained, I advised her to dilute the glycerine. This had the desired effect. The ear did not run, and felt comfortable even immediately after the insertion. She could wear the pellets a day longer than usual, three days in all, before she felt any annoyance.

• The condition of her ears on the day of the examination was as follows: Pellets in for 24 hours,  $h \frac{1\frac{1}{2}-2}{4}$ ,  $v \frac{2\frac{0}{0}}{6}$  each ear. The cotton-pellets removed are of moderate size, oblong, moist with some pus which is slightly greenish, almost free from odor. [When the discharge grows offensive and copious, she changes the cotton oftener and cleanses the ear more frequently and carefully, without, however, employing any remedy.] Her acuteness of hearing was R  $h \frac{1}{2}$ , on temple faint, on mastoid distinct;  $v \frac{3\frac{0}{0}}{6}$ ; L  $h \frac{1}{2\frac{1}{4}}$ ,  $v \frac{6\frac{0}{0}}{6}$ . The fundus of the right ear was covered with a moderate quantity of pus which required the introduction of the cotton-holder three times to remove it fully. In the left ear there was only a very small quantity of pus. In the right ear the handle lay bare and was united to the promontory; behind its upper part, close to the short process, was a vertical fold of pale-red mucous membrane, corresponding to the lower part of the

descending process of the handle. The mucous membrane of the promontory was red, even, and free from granulations. At the periphery there was a doubtful indication of a remnant of the drum-membrane. The mucous membrane of the left tympanic cavity was red, even, and thin. In the upper part of the cavity there was red fibrous-looking tissue, probably enveloping the ossicles. This tissue, as well as the adjacent part of the ear-canal, was covered with collections of white scales. She soaked the cotton-wafers with pure glycerine, introduced them as described above, and immediately heard well again, namely  $v \frac{2.0}{8.0} +$ , in each ear. A few minutes afterward I noticed clear liquid running from her ears.

I do not think that there is another case on record in which the cotton-pellets were worn twenty-nine years. If we bear in mind that Yearsley published his first observations in 1848, she must be one of the oldest patients that derived benefit from his method of treatment. She considered it the turning-point in her existence. It rendered her capable of receiving a good education, fit for society, and equal to the requirements of civilized life. Without it she would not have been in a much better condition than a deaf-mute.

Moreover, let us not forget the *protective effect* of the pellets. Before she wore the pellets, she had constant offensive otorrhœa with all its annoyances and dangers. The pellets, by judicious manipulation, enabled her to regulate the secretion in such a way as was most suitable for audition: on the one hand, checking the discharge when it showed a tendency to grow profuse; on the other, preventing the structures still preserved in the tympanic cavity from becoming sclerosed and stiff by exsiccation. And for twenty-nine years she has worn the pellets with comfort, free from inflammation and pain. To-day they benefit her hearing as much, and are as indispensable to her, as in the beginning, while the anatomical condition of the middle ears presents no degenerative processes, there being neither cicatricial atrophy of the mucous membrane (sclerosis) nor proliferation (granulations and polypi). There never has been any caries or mastoid complication. I think any practitioner, however skeptical, may take this case as a precedent for the management of similar ones.



Since I have paid more attention to this subject, I find that the group of cases in which the cotton-pellet affords material service, is much larger than I formerly believed it to be. Another illustrative example of recent date is the following:

CASE 2.—*Otorrhæa for 16 years. Cotton-pellets great aid to hearing.*

Mr. J. C., æt. 20, of New York, consulted me first Dec. 20, 1880. Ear disease and discharge from his fourth year. Hearing changing, but always bad. On examination  $h\ o$  in each ear,  $v\ R\frac{1}{6}\frac{0}{0}$ ,  $L\frac{2}{6}\frac{0}{0}$ ; audiphone  $\frac{6}{6}\frac{0}{0}$ ; dipper-trumpet  $\frac{1}{6}\frac{5}{6}$ . Moderate quantity of dark offensive pus removed with cotton-holder. Mucous membrane of drum-cavity red, slightly thickened. Drum-membranes not to be discovered. Toynbee's artificial *Mt* produced no improvement of hearing; a moistened cotton-pellet, pressed tight into the ears, gave  $v\ R\frac{1}{6}\frac{0}{0}$ ,  $L\frac{1}{6}\frac{5}{6}$ . Patient delighted. He heard well the whole day. After removal of the cotton, he heard badly again, nor did he succeed for a whole week in putting a fresh plug in that afforded great aid to his hearing.

He returned Dec. 27th.  $v\ \frac{1}{6}\frac{5}{6}$ ; with pellets  $\frac{5}{6}\frac{0}{0}$ ; unsatisfactory. No secretion. I advised him to leave the cotton-pellets, which were moistened with a 25-per-cent. solution of glycerine, in the ear for three days and then let me take them out. When he came, December 31st, I found  $v\ \frac{1}{6}\frac{5}{6}$ , and the pellets saturated with somewhat greenish pus. I ordered him to syringe his ears gently but carefully every morning and evening, put a 4-per-cent. solution of boracic acid in, and stop the ears up with dry absorbent cotton. In a week the discharge had disappeared. He was directed to introduce the cotton-pellets, moistened in glycerine and water, every morning, removing them in the evening, and cleanse the ear by syringing before the insertion and after the removal. In doing so he felt no inconvenience; the discharge was moderate and free from smell; and  $v$  varied from  $\frac{1}{6}\frac{0}{0}$  to  $\frac{1}{6}\frac{5}{6}$ , without the cotton it was never higher than  $\frac{1}{6}\frac{1}{6}$ . Any attempt at leaving the cotton-plugs longer than a day, was followed by increased discharge and diminution of hearing. On March 27th, *i.e.*, after three months' treatment, I made a careful examination, which showed the following: With pellets inserted by himself  $h\ \frac{1}{2}$  each,  $v\ R\ \frac{2}{6}\frac{0}{0} +$ ,  $L\ \frac{2}{6}\frac{0}{0} -$ . After removal of pellets  $h\ o$  (everywhere),  $v\ \frac{1}{6}\frac{5}{6}$ , each. No discharge; cleansed ears in the morning. Both ear-canals narrow, walls normal. In left ear no *Mt*, no ossicles visible, mucous membrane red, but only slightly swollen, with probe not ten-



der. In right ear cartilaginous ring preserved ; handle absent ; the place of the oval window covered with mucous membrane ; the entrance into the niche of the round window filled with liquid, slightly depressed, a small bright reflex in the centre. He inserted large cotton-pellets again, upon which  $L \text{ } \frac{1}{2}$ , ear and temple distinct, mastoid faint,  $v \text{ } \frac{1.5}{0.0}$  ;  $R \text{ } \frac{1}{2}$ , ear distinct, temple faint, mastoid 0 ;  $v \text{ } \frac{1.5}{0.0}$ .

In this case of almost total absence of the *Mtt*, where the ossicles could not be detected, and the otorrhœa was of fourteen years' duration, the cotton-pellets were a great aid to hearing, raising  $v$  from  $\frac{2}{0.0}$  to  $\frac{1.5}{0.0}$  in each ear. They caused no discomfort to the patient, but had to be changed every day, and the ears required cleansing twice daily. It is quite possible that they may be left longer when the discharge diminishes.

These two cases show that the cotton-pellets may be of material advantage to hearing, when there is a certain degree of discharge. In this condition they have to be changed daily, or every few days. There is another group of cases in which, as already Tröltzsch remarks, the pellets are of particular service to hearing, namely, when the tympanic cavity is too dry, and, I may add, when there is desquamative otitis media. It is generally known that many patients hear better when their ears run than when they are dry. Almost all these cases can be benefited by the moist cotton-pellet, which not only imparts moisture to the mucous membrane of the drum-cavity, but also prevents it from exsiccation by shutting it off from the atmosphere. I may be permitted to illustrate these conditions by two examples :

CASE 3.—*Otitis media chronica desquamativa. Acoustic and curative effects of cotton-pellets excellent.*

Mr. N. J. W., æt. 55, of New York, has been under my care, off and on, for six years. January 14, 1875, he consulted me first. Diagnosis : *R* otit. med. desquamativa, *L* sclerosis.  $v \text{ } R \text{ } \frac{2.5}{0.0}$ ,  $L \text{ } \frac{2.0}{0.0}$ . The disease resulted from scarlet fever when he was four years old. The right ear has discharged more or less all his life, the left only now and then. The hearing in each ear varied. Dec. 22, 1880, he came to me complaining

that for a week or two his hearing had been unusually bad, incapacitating him for his profession. I found  $v \frac{3}{6}$  in each ear. The left drum-cavity was sclerosed as before; the mucous lining of the right, and the adjacent parts of the canal were thickened and covered with white scales, most marked at the anterior wall of the drum-cavity. I filled the ear with warm soap-water, left in for half an hour. Into the left I introduced a moist cotton-plug. As the right ear could only imperfectly be cleansed by syringing, I swabbed it with cotton-wool. Then I removed the plug from the left ear. The handle was preserved in both ears, the drum-heads were almost totally absent. I soaked cotton-pellets in one part of glycerine to four parts of water, shaped them into wafer-like discs, and spread them carefully over the inner wall of the drum. At once the patient readily understood ordinary conversation across the room ( $v \frac{3}{6}$ ) with each ear. He felt comfortable, and went away delighted. I had directed him to leave the pellets undisturbed for two days, and come again. His hearing then was still  $v \frac{3}{6}$  in each ear, but there was an unpleasant discharge in the right. The cotton-plugs were removed, the right ear cleansed as before, the left was congested and slightly moist, but free from pus. Cotton-pellets were introduced again with the same result. Patient left them in for four days; in the left the pellet was scarcely moist, in the right there was considerable and offensive discharge. It was now possible to cleanse the right ear completely from the tenacious deposits of white scales. Patient was advised to change the cotton-pellet in the right ear every day, and leave it in the left for a week. When he returned there was only little and inodorous discharge in the right. In the left the cotton-pellet was dry and lay in the middle of the ear-canal. The patient's hearing was now  $v \frac{3}{6}$  in each ear, whether he had the cotton-pellets in or out. He was directed to wear only a very thin piece of dry cotton in the right, and a very thin cotton-wafer, soaked with the glycerine lotion, in the left, either on the inner wall of the drum or near it. In this way the patient does very well. He comes to see me from time to time, and according as I find the condition of the drum-cavities, I advise him to modify his treatment.

*CASE 4.—Large defects in drum-heads; R chronic otorrhœa; L no discharge. Cotton-pellets improve hearing in both ears, and rapidly cure the discharge in the right.*

Quite recently, March 25th, Miss A. M. T., æt. 28, of this city, came to me. She had had otorrhœa from her childhood. I found

large perforations in both *Mtt*, the handle preserved only in the left ear, the mucous membrane of which was not swollen ;  $v \frac{1}{6} \frac{5}{0}$ , with cotton-pellet  $\frac{2}{6} \frac{0}{0}$ . R discharge moderate ;  $v \frac{1}{6} \frac{1}{0}$ , with pellet,  $\frac{4}{6} \frac{0}{0}$ . Directed to wear the cotton-pellets, soaked in glycerine-lotion, in both ears for several days. She returned six days later. The cotton-plug in the right ear was saturated with thick pus ; that in the left was dry. Pellet introduced again in the right ear only. Three days later it came out only slightly moist. There was no discharge. Syringing removed only inspissated granules and flakes. Mucous membrane red and moist.  $v \frac{2}{6} \frac{0}{0} +$ , after reinsertion of pellet,  $v \frac{2}{6} \frac{0}{0} -$  ; L mucous membrane somewhat moist ;  $v \frac{2}{6} \frac{0}{0}$ . A thin piece of cotton to be worn only in outer part of the ear-canal. Four days later the hearing in each ear was  $v \frac{2}{6} \frac{0}{0}$ . The cotton in the right ear was dry. It adhered to the inner wall of the drum. Removed with a forceps it showed a white, dry pellicle, 5 *mm*. in diameter, attached to its inner end. Some scales on the ear-canal. Water passed from the ear into the throat. Mucous membrane not swollen. Cotton only in outer part of canals. Two days later she returned ;  $v \frac{2}{6} \frac{0}{0}$ , L  $\frac{1}{6} \frac{0}{0}$ . A flake of mucus was on posterior lower part of inner wall of left drum. Syringed out. Pellets, moistened with glycerine lotion, inserted into the depth of both ears ;  $v \frac{2}{6} \frac{0}{0} +$  in each. Patient feels very comfortable.

She stated that the right ear had discharged more or less, and the hearing in it had been dull as long as she could remember. The left ear had almost always been dry, the hearing in it very changeable ; better when it ran. At times she removed the deafness by syringing. April 8th, when she presented herself last with no discharge but good hearing ( $v \frac{2}{6} \frac{0}{0} +$ ) in either ear, she was directed to protect the ears with small pieces of dry cotton, placed at the entrance of the canals, as long as she heard well and felt comfortable, but to put moist (glycerine, 1 part ; water, 3 or 4 parts) pellets deep in when the ears were dry and the hearing was bad. Other directions I need not mention.

I abstain from reporting other observations. The four cases here described will serve as evidence for the points which I desired to make, and which I may summarize in the following statements :

1. Cotton-pellets, moistened with glycerine and water (1:4), and worn as artificial drum-heads, are a great aid to

hearing in many cases of partial or total defect of the natural drum-head, with or without otorrhœa.

2. Their therapeutical action in arresting profuse discharge on the one hand, and preventing the mucous membrane of the drum-cavity from drying up on the other, is most valuable.

3. They protect, like the natural drum-heads, the deeper parts of the ear against injurious influences of the atmosphere.

4. In some cases they are quite indispensable, and may be worn for a lifetime with permanent comfort and benefit.

5. In other cases they are needed only periodically, according as the copiousness of the discharge or the exsiccation of the mucous membrane requires their action in the one or other direction.

6. The period during which a pellet may be left in the ear varies with the condition of the parts. They should be changed frequently, *i. e.*, every day, or every few days, so long as the discharge is considerable. They should not be worn at all when the discharge is abundant and offensive. When there is no discharge, they may be left as long as they are comfortable and the hearing is good. So far as my experience goes, they are apt to become unclean in a week or two. They then ought to be removed, the ear cleansed either with dry cotton, or cotton steeped in warm soap-suds, and new pellets introduced.

7. The management of the ear-disease should remain in the hands of the physician until a stationary condition, either of slight or no discharge, has been reached. During the time the patient is under treatment, he can be taught how to cleanse his ears and remove and replace the pellets.

It was not my object in this paper to consider the mode of action of the artificial drum-head, nor its value in the restoration of defects in the membrana tympani. I purposed, on my part also, to call attention to the acoustic and therapeutical importance of the cotton-pellet. If my remarks are of no account, the cases reported, added to those of other observers, are certainly qualified, not only to justify but to stimulate efforts of investigation in this direction.

## QUARTERLY ABSTRACT OF AMERICAN OTO- LOGICAL LITERATURE.

BY SWAN M. BURNETT, WASHINGTON.

1. Functions of the Eustachian tube. By T. F. RUMBOLD, *St. Louis Med. and Surg. Jour.*, July 20 to September 5, 1880.

The conclusions at which R. arrives from a number of observations which are given in full, are :

"1. That during the act of deglutition, the Eustachian tube is *not* an open passage into the tympanum.

"2. That the walls of the Eustachian tube are constantly in slight contact.

"3. That the air continuously permeates the Eustachian tube into the tympanic cavity.

"4. That the air in the normal tympanic cavity is not of equal density with that of the surrounding atmosphere, the air in the tympanum being rarefied.

"5. One of the functions of the Eustachian tube, may be the principal one, is the maintenance of this inequality of air-density.

"6. That the rarefied condition of the air in the tympanum is the cause of the uniform concavity of the *Mt*.

"7. That a certain degree of uniform pressure on the fluid in the internal ear, by means of the *Mt* and the small bones of the ear, is essential to normal hearing."

2. On the sympathy existing between the ear and the larynx, and the ear and the teeth. By C. H. BURNETT. *Specialist and Intelligencer*, November, 1880.

Dr. B. relates some cases which, he believes, substantiate the reflex connection between the ear and teeth, and the ear and larynx.

3. Otorrhœa. Hints on treatment. By H. GRADLE. *Chicago Med. Review*, December 20th.

He uses the antiseptic method. Has found 5 per-cent. solutions of carbolic acid very useful where there is much fetor, but the least annoying of all applications is powdered boracic acid poured into the ear after thorough cleansing and drying.

4. Report, in brief, of the Aural Department of Jeff. Medical College Hospital. L. TURNBULL, in charge. *Med. and Surg. Reporter*, January 15th.

During the year, 208 new cases were treated, and 49 operations performed. Inflation by Politzer or the catheter, with hydrobromic ether, was found to be beneficial in tinnitus aurium, as were also 15 drops of hydrobromic acid after meals.

5. On false hearing and autophony in singers, speakers, and performers on certain musical instruments. By SAMUEL SEXTON. *N. Y. Med. Record*, January 22d.

S. defines pseudacousma (false hearing) as that condition in which the sound of the speaker's own voice, instead of coming from the outside, appears to come directly from the throat into the auditory apparatus. This autophony is false as regards the normal manner of hearing one's own voice, and may also be false as regards pitch and timbre. In treating of this anomaly, as found in musicians, he divides his patients into two classes: vocalists, and performers on musical instruments, giving eleven cases in all.

He concludes from a study of these cases that the trouble in most instances is to be found in the middle ear—and not in the labyrinth as has been commonly believed. The abnormal conditions being, as he supposes, alterations in the ossicular connections and a relaxed condition of the *Mt.*

In the discussion of this paper in the New York Academy of Medicine (same number of the *Record*) Dr. ROOSA expressed a decided difference of opinion from the author as regards the seat of the morbid process in this class of cases. Though the middle ear was often involved, it was only when the labyrinth was secondarily affected that false hearing was noticed.

Dr. KNAPP classified the various forms of false hearing according to the fundamental qualities of sound, intensity, pitch, and clang-tint. He had never seen a case where the last was affected. Intensity of sounds was influenced by abnormal conditions of the



conducting apparatus, the condition of the Eustachian tube being an important factor. Anomalies in pitch, however, he could not explain in this way. For the production of this, there must be, from some cause, a false tuning of one of the cochleæ or part of it. Confused or muffled hearing was caused by defective isolation and damping of the fibres of the basilar membrane. Anomalies of pitch, in cases of inflamed drum-cavity, were due to propagation of the morbid process from this point to the inner ear. Prognosis in such cases is, as a rule, good.

Dr. O. D. POMEROY agreed in general terms with the opinions of the essayist, but thought there was defective tuning of the fibres of Corti. More light, however, was needed before a positive opinion could be formulated.

Dr. HOLCOMBE thought that in his own case, the phenomenon of double hearing was due to pressure on the labyrinthine fluid, but the trouble disappeared when the mucus, which had collected in the middle ear, was removed.

In closing the discussion, Dr. SEXTON said it was difficult to establish the use of Corti's organ. Did it separate compound tones? He thought the mental act necessary to their perception, and comprehension did not require a cognizance of the separate elements of tones, as it probably receives them as a whole. The combination he believes to be made before transmission to the nerve of hearing takes place. As regards the semicircular canals, he had these structures in his possession taken from one ear of a patient who lived and walked as well as any one.

6. Suppurative inflammation of the middle ear. By W. T. MONTGOMERY. *Trans. Ill. State Med. Soc.*, 1880.

A general survey of the subject of chronic suppuration of the middle ear, in which there is nothing new offered to the specialist.

Imperfect hearing, and the hygiene of the ear. By LAURENCE TURNBULL, M.D. 8vo, pp. 147. Philadelphia : J. B. Lippincott & Co., 1881.

This brochure is the third edition of Dr. Turnbull's pamphlet on "Tinnitus Aurium," published some years ago. This is sufficient evidence of its popularity. Much additional matter has been introduced, and we have now a collection of monographs on several subjects which are of great interest to otologists. Dr. T. has thoroughly posted himself on the literature of the subjects on

which he writes, and his own experience and observation have contributed largely to the value of the several papers.

The subjects treated of include an "Introduction," giving the recent progress of otology ; "The limit of perception of musical tones by the human ear ;" "Tinnitus aurium, and observations on aural or auditory vertigo, with diagnosis and treatment ;" "The importance of treatment of the naso-pharyngeal space, tonsils, and uvula, in acute and chronic catarrh of the middle ear ;" "Artificial perforation of the membrana tympani ;" "The mastoid region and its diseases, with illustrative cases ;" "The hygiene of the apparatus of hearing, with the prevention of deafness ;" "On the method of educating the deaf-mute at home, and on the selection of proper schools for the deaf and dumb ;" "A comparison between the audiphone, dentaphone, etc., and the various forms of ear-trumpets."

Diagnosis and treatment of ear diseases. By A. H. BUCK, M.D. pp. 411. New York : Wm. Wood & Co., 1880.

This work of Dr. Buck's is of special interest to the aurist, from the fact that it is a record of his personal experience on all the topics touched upon. He has wasted no time in giving those views and opinions of others which his observation has taught him are of less value than those he has adopted. There are many points of interest, particularly where he has dissented from the views held by almost common consent, which we should like to touch upon, but our limited space forbids us doing so in any great detail. In the first place, he recommends that in the removal of foreign bodies, cerumen, etc., from the ear, the syringe should be the exception rather than the rule. If the work were intended solely for the use of experienced specialists, no great harm might come from this teaching, but we cannot but believe that such a statement, coming from such an acknowledged authority as Dr. Buck, and in a work belonging to a series intended rather for the library of the general practitioner than for the specialist, is likely to be pernicious in its results.

In the treatment of catarrh of the middle ear he is opposed to intratympanic injections, and only in rare cases performs paracentesis of the *Mt.* In the purulent form, however, he does puncture as soon as there is any marked bulging of the drum-head. He treats the pharynx by means of argt. nit. in sol. of from 15 grs. to 40 grs. to  $\frac{5}{8}$  i. aq. This is applied by means of cotton on a cotton-holder bent nearly at right angles so as to allow it to be pushed

well up behind the palate. For inflation he prefers Politzer to the catheter, and he thinks that, as a rule, inflation every other day is of sufficient frequency. He seldom continues treatment for longer than four or five weeks. He then gives a rest for a few weeks to resume treatment again. In the dry form of catarrh, which he calls "chronic subacute catarrh," when the diagnosis is unmistakable, there is little or no hope for benefit from treatment.

The chapter on purulent inflammation of the middle ear is one of peculiar excellence. He has come, as the result of his experience, to use no astringent but argt. nit., except in rare instances. He does not express it as a positive opinion, but thinks that syphilis may manifest itself in the middle ear. His chapter on diseases of the mastoid is one which every otologist should read, while that on fractures of the temporal bone could be read with profit as well by the general surgeon.

## REPORT ON THE PROGRESS OF OTOLOGY IN THE THIRD QUARTER OF THE YEAR 1880.

Translation by R. C. BRANDEIS, M.D., of New York.

### I.—NORMAL AND PATHOLOGICAL ANATOMY OF THE ORGAN OF HEARING.

BY DR. H. STEINBRÜGGE, OF HEIDELBERG.

1. C. F. W. ROLLER (Anatomical Institute, Strassburg). The ascending root of the acoustic nerve. *Archiv für Microscopische Anatomie*, vol. xviii, part 4, page 403.
2. Dr. LEO GERLACH. (a) The preparation of the ossicles of the human ear as specimens for demonstration. (b) On the presence of two ampullæ in the outer (horizontal) semicircular canal of the bony labyrinth. Meeting of the Physico-Medical Society of Erlangen, Nov. 10, 1879.
3. H. KRATZ. On congenital fistula of the first branchial fissure. Inaugural thesis, Bonn, 1880.
4. Dr. EVE. Aneurism by anastomosis of the ear. Demonstrated before the Pathological Society of London, April 20, 1880. *British Medical Journal*, April 24, 1880.
5. J. CLARENCE BLAKE, M.D., Boston. On the occurrence of exostosis within the external auditory canal in prehistoric man. *American Journal of Otology*, vol ii, No. 2.
6. EDWARD ZILLINGER. Aural hemorrhage in suicide by hanging. *Wien. Med. Wochenschrift*, Nos. 35 and 36, 1880.
7. LEWIS W. REYNOLDS. Case of perforation of the membrana tympani from *ascaris lumbricoides*. *The Lancet*, Oct. 23, 1880.
8. HENRY MORRIS. Contributions on mastoid disease. *Lancet*, May 28, 1880.

9. E. KELLER, Cologne. Additional contribution to the knowledge of necrosis of the temporal bone. *Berlin Klin. Wochenschr.*, No. 44, 1880.

10. THOMAS BARR. Three cases of cerebral abscess consequent upon suppurative disease of the middle ear; with remarks. *The Glasgow Medical Journal*, vol. xiv, No. 7, July, 1880.

11. J. LUYS. Contributions to the study of cerebral localization; long-standing deafness; atrophy of both occipital lobules. *Gazette Médicale*, No. 29, 1880.

12. MARTIN SAALFELD, Stettin. On the so-called pharyngitis granulosa. *Virchow's Archiv*, vol. lxxii, part 1, page 147.

1. According to Roller, the ascending root of the acoustic nerve arises from the funiculus cuneatus of the cervical portion of the spinal cord (which contains numerous large, round cells), from which longitudinal fascicles branch off, which can be traced into the large-celled acoustic focus (Henle's upper acoustic nucleus). They contribute to the formation of the inner root of the acoustic nerve (Henle's posterior medial cord), inasmuch as a part passes directly into it, while another first unites with the cells of the focus. A second bundle, which enters the same focus, comes from above through the pons Varolii, as well as other fibres from the cerebellum. The large-celled focus is, therefore, a central meeting-place for different bundles of fibres.

2 (a). GERLACH glues small discs of wood, about 3 mm. in thickness and 12 mm. in diameter, upon microscope slides, fastens one of the ossicula auditūs to the glass slides by means of glue, and seals the cavity with a glass cover which is firmly adherent to the wooden disc. By this means the specimen can be examined from all sides. In order to demonstrate the mutual relations of the ossicula, one to another, fine platinum wires are glued to them; the other end inserted into a cork disc in such a manner that the normal position of the bones is established. The vibrations of the ossicula and their axis of vibration can be shown by suspending the chain of bones between two small up-rights, 3 cm. apart, by means of threads, one of which is attached to the handle of the malleus, the other to the short crus of the stapes.

(b.) GERLACH found, in a left human petrous bone whose vestibule was opened from behind, that the posterior end of the hori-

zontal semicircular canal was dilated, like an ampulla. He supposes that there may have been two ampullæ, because, in accordance with the mode of development, the cartilaginous labyrinth is first formed, and the shape of the bony canal is determined thereby.

3. KRATZ has himself seen twelve cases of congenital fistulæ. They are often associated with other malformations of the ear. One-half the cases were hereditary. These fistulæ must be looked upon as a partial maintenance of the first branchial fissure, and for this reason the author calls them as above. It was never possible to find any communication with either the external meatus or the tympanic cavity in spite of careful probing or inflation with air.

4. EVE showed the case of a girl aged 21 years. At birth, a small pulsating tumor was noticed on the right auricle, which, when she was about fifteen years old, was removed by means of ligation. It reappeared, and two years later was again operated on, but finally involved the entire auricle. The tumor pulsated slightly; a buzzing sound could be heard. The right common carotid, the temporal, and posterior auricular arteries were dilated. On examination with the microscope a dense network, composed of arterioles and capillaries, was found.

5. BLAKE examined the external auditory canals in the crania of prehistoric mound-builders. He verifies Turner's observation, that a congenital sagittal compression of the external canals, independent of any artificial malformation of the skull, is often found. In 195 skulls the average sagittal diameter was 6.3 mm. In 18 per cent. there were exostoses in one or both canals, and the antero-posterior diameter was reduced to 5.7 mm. In 50 Californian crania, taken from the graves of the islands off Santa Barbara, the antero-posterior diameter averaged 8.61 mm.; of 108 other Californian skulls, 5 showed exostoses. The causes are unknown; no traces of syphilis were found. Blake accepts Welcker's and Turner's suggestion, that these exostoses in the auditory canals are not peculiar to American crania and can probably also be found in those of the old world as well.

6. ZILLINGER reports the results of the *post-mortem* examination of a female suicide. Cyanosis of the face. Eyelids, conjunctiva, and the mucous membrane of the lips contained numerous ecchymoses. The cutis of the right meatus was detached in shreds. On the drum-membrane there was a linear rupture of



the epidermal layer. Near the umbo there were several small ecchymoses. The cavity of the tympanum was filled with blood, its mucous membrane markedly congested and also studded with ecchymoses. On the left side the conditions were almost the same. Zillinger calls attention to the gradual compression of the large vessels of the neck in attempts at suicide by hanging, and the congestions resulting therefrom. In this, as in Hofmann's cases, there were cyanosis of the face and extravasation into the mucous membranes. In 23 cases of asphyxiation from different causes, there were ecchymoses of the auditory meatus in three cases, and of the cavity of the tympanum in fifteen cases.

7. REYNOLDS' case concerns a pregnant woman, aged 35 years, suffering from ascarae, who passed several of them during emesis. Several lodged in the nasal fossæ and caused epistaxis; others entered the Eustachian tubes and also gave rise to hemorrhages, intense pain, and, after having perforated the membranæ tympanorum, crept out of the ears. From March 4th to 8th six worms, one of them four inches in length, passed through the tubes and the external ears.

8. MORRIS reports two cases of disease of the mastoid process: 1. A man, aged 31 years, deaf for many years and suffering from otorrhœa. Pain, increased discharge, redness over the left mastoid process, chill, loss of consciousness. Trephined, temporary improvement, then symptoms of pyæmia. Herpetic vesicles in the face, which increase and coalesce; these were also found on the tongue as well as on the mucous membrane of the mouth and pharynx. At *post-mortem* the left lateral sinus and the jugular vein were occluded by a firm, adherent thrombus, which extended as far as the opening of the subclavian vein. In the right lateral sinus and torcular Herophili the coagulum was not so dense. The second case was that of a man, aged 50 years, who was affected with deafness and mastoid trouble of the left side after taking a cold bath. The membrana tympani presented no abnormal symptoms. Wilde's incision was made, and the patient recovered speedily.

9. KELLER removed a sequestrum from a scrofulous boy two years of age, which projected from a fistula situated behind and above the right auricle. The fragment of bone was  $2\frac{1}{2}$  cm. long,  $2\frac{1}{4}$  cm. broad, and  $1\frac{1}{2}$  cm. thick; a part of the sigmoid sulcus, 1 cm. in length, the tegmen tympani, and cancellous bone from the neighborhood of the labyrinth were distinguishable. There was

paralysis of the right facial nerve. Three years later Keller saw the child again. The fistulous opening was still present, and the otorrhœa persisted ; the paralysis was less marked, but the right side of the face was not as well developed as the other. The defect in the temporal bone was replaced by newly-formed bone tissue. The vibrations of the tuning-fork were perceived by bone-conduction.

10. BARR's first case was that of a boy, aged 14, who had had otorrhœa for more than 10 years, and who, after receiving a box on the ears, vomited, became feverish, and had pain on the left side of the head. Eleven days after the injury there was coma, spasmodic contraction of the flexors of the arms and legs. Death ensued. A large abscess was found in the left temporal lobe. The dura mater above the roof of the left tympanic cavity was thickened and softened. No caries. The membrana tympani was destroyed ; tympanic cavity filled by a soft, polypoid mass. Malleus and sinus bathed in a brown-colored fluid ; stapes not to be found.

The second case was that of a boy, aged 17, who had been deaf for eleven years. For two years past there had been occasional discharges from the left ear. After taking sea-baths he became ill, suffered severe pains, was very much prostrated, slightly aphasic, very somnolent, vomited considerably, and was constipated. Ten days later he was able to rise again and, with halting gait, went into an adjoining room. In the evening there were general tremor and unconsciousness. Paresis of the right side ; the day after, coma and death. Large abscess in the left temporal lobe. A carious fistula in the roof of the antrum ; a second one in the sigmoid fossa, and a third in the posterior upper wall of the external meatus. All of these fistulæ communicated with the mastoid cells. The upper half of the membrana tympani was destroyed.

The third case was that of a boy of 12, who for six years had otorrhœa of the left side, after an attack of measles. There was pain in the left mastoid region and in the occiput ; chilliness, vomiting, constipation. A week later, chills, which occurred several times daily. Three weeks after the illness began, the patient died. There was an accumulation of foetid pus beneath the dura mater, on the posterior surface of the left petrous bone. The walls of the left lateral sinus were thickened, and detached from the bone by underlying pus. The cavity of the sinus was

intact. Brain healthy. Membrana tympani and the ossicles destroyed. Mastoid cells filled with cheesy matter. No caries.

11. LUYS had a patient, aged 85 years, who had been quite deaf for 60 years, died of pneumonia. The left occipital lobe, which was quite atrophied, presented an irregular, stunted surface. The central sulcus (scissure perpendiculaire) was transformed into a deep gutter, so that the index finger could be imbedded in it. The groove which separates the *pli courbe* (lobulus tuberis) from the posterior central convolution, is also enlarged. The third frontal convolution is atrophic. The right occipital lobe is also lessened in size by atrophy of the cortical substance; the sulci are enlarged. The trunks of the auditory nerves have disappeared, with the exception of a few fibres. Luys quotes the *Annales des Maladies de l'Oreille* of 1876, where he published the case of a deaf-mute, aged 74 years, who, on *post-mortem*, also had atrophy of the occipital lobe.

12. SAALFELD only examined the oral portion of the pharynx. The granula, even without a microscope, often showed a small opening, the dilated orifice of the excretory duct of an acinous gland, generally enlarged and lying in the submucous layer. The neighborhood of the excretory duct is infiltrated with lymphoid cells, which in part have united to form circumscribed follicles. The normal pavement epithelium, composed of several layers, is absent in the apex of the granules. The mucous membrane between the granules is, in some cases, quite healthy; in others, thickened and infiltrated.

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## II.—PHYSIOLOGY OF THE EAR AND PHYSIOLOGICAL ACOUSTICS.

BY OSCAR WOLF, OF FRANKFORT-ON-THE-MAIN.

1. CLARENCE J. BLAKE, Boston. The membrana tympani telephone. *The American Journal of Otology*, vol. ii, No. 3.

2. ALEXANDER GRAHAM BELL, Tufts College, Mass. Experiments relating to binaural audition. *Ibidem*.

3. J. DOGIEL. The influence of music on the circulation of the blood. *Archiv f. Anat. und Physiol.*, by E. Du Bois Raymond, physiological section, parts 4 and 5, 1880.

4. R. FALKSON, Königsberg. Contribution to the knowledge of the function of the soft palate and pharynx. *Virchow's Archiv*, vol. lxxix, part 3.

5. E. BERTHOLD, Königsberg. On the influence of the nerves of the tympanic cavity upon the secretion of its mucous membrane. Address delivered in the section of laryngology. Reprint from the transactions of the 53d Congress of German Scientists and Physicians.

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1. CLARENCE J. BLAKE, who, as has already been reported, has done much to adapt the telephone for acoustic experiments, endeavored to utilize the human membrana tympani in perfecting the telephone. He prepared suitable specimens by opening the roof of the tympanic cavity and then removed the posterior portion of the petrous bone by carrying a hair-saw through the tympanic cavity from before backward, through the incudo-stapedial articulation, and exposing the inner surface of the membrana tympani with the malleus and incus in position. The specimens were washed with glycerine in order to maintain their mobility. A telephone was made whose receiving plate was equal in diameter to that of the membrana tympani; the handle of the malleus and the long process of the incus were attached to the ferro-type discs by means of resin-wax. Two of Bell's hand-telephones were attached to the conducting wire so as to have the experiments under thorough control. The results obtained were not satisfactory. When, for instance, the limit of transmission of the ordinary telephone was found to be 10.240 V. S., with the ear-telephone it was only 8.192 V. S. The tones of pipes, from 680 to 800 V. S., were plainly but faintly heard. Single tones and single vowel and consonant sounds were distinguishable, but it was again found that the consonant sounds accompanied by the greatest pneumatic pressure in their production were all heard merely as dull thuds. Having tested the ear-telephones together as transmitting and receiving instruments, one was removed and a Bell hand-telephone substituted as a transmitter; under these circumstances not only were the musical tones much more distinctly and loudly heard, but it was also possible to carry on conversation in one direction, using the ear-telephone as a receiver. It is thus found that the addition of the curved animal membrane affords no advantage for the use of the telephone.

2. A. GRAHAM BELL bases his experiments upon the fact that when we close one ear and listen to sounds through the medium of the other, we can distinguish pitch, loudness, and quality of such sounds, yet there is a feeling of incompleteness, especially in our ability to determine the origin of the sounds heard. This

uncertainty is compared with monocular vision. When both ears are employed simultaneously, a sort of stereoscopic effect of audition is perceived. In order to study these stereoscopic phenomena of binaural audition, Graham Bell arranged four telephones in such a manner that the two mouth-pieces were turned away from one another, and the instruments were so arranged that the diaphragms were about as far apart as the drum-membranes of the two ears. The left mouth-piece was connected with the left ear-piece of the receiver in an adjoining room, and the right one with its fellow also. The speaker now passed in a circle round the two mouth-pieces, and the receiver tried, while holding the two ear-pieces to his respective ears, to determine from what part of the room the sound emanated. The result of those experiments will be given further on. Another series of observations was made in the open air, two microphones being also employed whose diaphragms were about six inches apart and back to back. Here the author describes as new a method, recommended to him by Mr. Sumner Taintor, of introducing artificial resistance into the two telephone circuits. Graham Bell, at this time, was probably not acquainted with the works of Arthur Hartmann, Plu-maudon, and B. Richardson, although they were already published eighteen months ago. By introducing a greater or less resistance into the circuit of one of the two microphonic telephones, a similar condition is established as if the observer were deaf in one ear. The author adds, in conclusion: "The experiments are too few in number and too imperfect in several respects to admit of accurate generalization, but it will be seen that perception of the direction of a source of sound is less perfect by a single ear than by both ears; while the tables disprove the idea that direction cannot be appreciated by monaural observation. It will also be observed that the direction of sound is more accurately defined as it approximates to the axial line of the ears, and that the indications are proportionately at fault as the true source of sound is in any other direction. When the source is  $90^{\circ}$  from the axial line, there is often an angular error amounting to  $180^{\circ}$ . When the source of sound is at the nadir of the observer, the perception of its direction is absolutely unreliable. This may arise from the sound being equally reflected from the ground on all sides. I have repeated the experiment a number of times upon different individuals, but have not found one who had the slightest idea of the true direction of a sound produced beneath him."



3. In his introduction DOGIEL remarks, that the Greeks already were aware of the influence of music upon the human body, and, according to Pythagoras, music was considered as a curative agent in the treatment of certain diseases. So far, the experiments made in Vulpian's\* laboratory were the only ones known. These proved that, in dogs, the excitation of the senses (taste, smell, hearing, and vision) sometimes retarded and sometimes accelerated the number of heart-beats, but the blood-pressure was invariably increased from 6 to 8 *cm*.

The résumé of Dogiel's experiments is as follows :

a. Music exercises an influence upon the circulation of man as well as that of animals.

b. The blood-pressure may increase or may diminish. These variations of the pressure of the column of blood depend mainly upon the influence of the excitation of hearing upon the spinal cord, which, to all appearances, is in connection with the auditory nerve.

c. The effect of musical tones and utterances on animals and on man manifests itself mainly by increasing the contractions of the heart ; the automatic cardiac ganglia must, therefore, be in greater activity.

d. The variations in circulation, due to the influence of music, coincide with those of respiration, although they have also been noticed independently.

e. Strychnine increases the effect of auditory excitation upon the circulation, but curara diminishes it.

f. Chloral hydrate, as well as ethyl-alcohol and morphine (in a certain stage of narcosis), diminishes the effect of the auditory excitation upon the circulation.

g. The variations in the circulation are dependent upon the *pitch* and *intensity* of the tones and upon the *clang-tint*.

h. In these variations of the circulation the peculiarities of the animal and man exert considerable influence, as does also the nationality of the latter.

Heretofore it has been assumed that the beneficial effects of music have been due to psychical stimulation. If the increase of the blood-pressure, as Dogiel's experiments go to prove, is due to a reflex action of the cardiac nerves, which also originate in the medulla oblongata, and, thereby, the action of the cerebrum is

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\*De l'influence des excitations des organes des sens sur le cœur et sur les vaisseaux. *Comptes rendus*, I, lxxxv, No. 3. Note de Messrs. Couty et A. Charpentier, présentée par M. Vulpian.



more or less impaired, then this matter is of increased importance from a hygienic standpoint. Music would then be a remedy which, without the assistance of the cerebrum, would favorably affect the functions of the heart and that of respiration also. By improving the circulation it would increase assimilation and favor physiological metamorphosis. Experience gathered at musical performances agrees, in a measure, with these experiments.

Only a short time after the music has begun we can notice a change in the audience, which points to an increase of the blood-pressure. The skin and mucous membranes are congested, particularly the auricles, the pulse is fuller, the eyes are brighter, the facial expression indicates content. The increase of warmth cannot be ascribed to the elevated temperature of the hall, because the reviewer has found that these physiological changes occur as well when the auditorium is not heated but simply illuminated by daylight, and the most careful measurements fail to detect any noteworthy changes in the temperature. That the activity of the cerebrum is not increased by the music may be inferred from the fact that not a few fall asleep during the performance.

4. FALKSON had an opportunity to study this subject on a patient in whom there had been a partial resection of the orbital cavity for the removal of a carcinoma. The opening left enabled him to gain a view of the naso-pharyngeal cavity. By adjusting a lever whose short arm rested on the velum palati while the long arm had a pencil attached to it, he was able to perceive the curves which the movements of the palate made upon the utterance of different sounds. He also describes the changes in the configuration of the naso-pharynx during phonation. We can only mention the fact that the muscular effort exerted by the soft palate during phonation, is much greater than was supposed. In order to prevent the elevation of the soft palate, the author was compelled to employ considerable force by pressing a metallic catheter on it. During respiration the soft palate was quite passive. The soft palate is raised when snoring, but the prime factors are the tremulous movements of the uvula and posterior pillars of the fauces ; at the same time the root of the tongue is raised—particularly during expiratory snoring—and the aditus faucium is contracted. The naso-pharynx is most contracted during deglutition and most completely separated from the pharyngo-laryngeal cavity.

Unfortunately the examination of the openings of the Eus-

tachian tubes was attended with difficulty, but their appearances differed from Zaufal's and Voltolini's descriptions. Whether the conditions were due to inflammatory swelling or to some malformation could not be definitely determined.

5. As Gellé's\* and Hagen's† views as to the physiological action of the nervous supply of the tympanic mucous membrane are contradictory, BERTHOLD determined to make a series of experiments upon squirrels, in order to settle this point, and in the hopes of solving the question as to the existence and nature of the so-called trophic nerves. He deemed it best not to limit his investigations to the trigeminus, but extended them to the other two nerves supplying the tympanum, *i. e.*, the glosso-pharyngeal and sympathetic. His labors were divided into the following series :

1. Intracranial division of the fifth pair.
2. Division of one-half of the medulla oblongata in order to destroy the origin of the trigeminal nerve.
3. Extirpation of the superior sympathetic ganglion.
4. Evulsion of the glosso-pharyngeal nerve.

In consideration of the large number of squirrels (more than 100) operated on, and the great care taken in the division, Berthold's results may be looked upon as definitive, even though they may be at variance with those arrived at by Hagen. So much is settled : "that injuries of the sympathetic and glosso-pharyngeal nerves exert no influence upon the tympanic mucous membrane of the squirrel. On the other hand, injuries of the trigeminus, at its roots in the medulla oblongata, and also in the cranial cavity, anterior to the Gasserian ganglion, do cause changes in the mucous membrane of the tympanum, which pass through all the stages of inflammation from simple vascularization to purulent exudation."

Prof. Berthold will, hereafter, subject the nerves operated on to simple irritation in order to throw more light on this obscure subject.

### III.—PATHOLOGY AND THERAPEUTICS OF THE EAR.

BY A. HARTMANN, BERLIN.

1. LADREIT DE LACHARRIÈRE. Deafness. Its degrees, causes, and the different apparatuses which have recently been devised for its relief. *Annal. des Mal. de l'Oreille*, etc., No. 1, 1880.

\* Gellé : Lésion de la muqueuse auriculaire à la suite des lésions bulbaires. *Gaz. Méd. de Paris*, 1878, No. 1.

† See review in these ARCHIVES, vol. ix, No. 2.

2. CRESSWELL BAKER. Report on 100 cases of ear-disease. *Lancet*, Aug. 7, 1880.
3. W. KIRCHNER, Wurzberg. Contributions to the knowledge of injuries of the ear. *Aertzl. Intelligenzbl.*, No. 30, 1880.
4. GUROVITSCH, Odessa. On the question of ear-symptoms in Bright's disease. *Berl. Med. Wochenschr.*, No. 42, 1880.
5. SAMUEL SEXTON. Tinnitus aurium. *The Amer. Journal of Otology*, vol. ii, page 193.
6. LUCHHAU, Königsberg. On diseases of the ear and eye in relapsing fever. *Virchow's Archiv*, vol. lxxxii.
7. H. KNAPP, New York. On heredito-syphilitic affections of the ear. *These ARCHIVES*, vol. ix, part 2.
8. D. B. ST JOHN ROOSA and E. ELY. Clinical contributions to otology. *These ARCHIVES*, vol. ix, part 2.
9. S. MOOS, Heidelberg. On the diseases of the ear in locomotive engineers and firemen, etc. *These ARCHIVES*, vol. ix, part 4.
10. CRESSWELL BAKER. Growth of fungi in ear-syringes. *British Med. Journal*, July 24, 1880.
11. A. POLITZER, Vienna. A new powder-blower. *Wiener Med. Wochenschr.*, No. 47, 1880.
12. E. ZAUFAL. On the value of the Nitze-Leiter endoscope in the examination of the ear. *Archiv f. Ohrenheilk.*, vol. xvi, page 188.
13. GARDINER BROWN. New standard of measurement for hearing-power, etc. *The Lancet*, July 24, 1880.
14. G. CZARDA, Prague. On the audiphone and its usefulness in deafness. *Wien. Med. Presse*, No. 30, 1880.
15. ALFRED NORTH. Two cases of poisoning by the oil of chenopodium. *The Amer. Journal of Otology*, vol. ii, p. 197.
16. A. HARTMANN. Deaf-mute statistics of the Province of Pomerania and the District of Erfurt. *These ARCHIVES*, vol ix, No. 4.

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1. LADREIT DE LACHARRIÈRE first discusses the different methods of testing the hearing-power, and expresses his doubts about their value. The different diseases which may cause deafness or greatly impair hearing, such as occlusion of the external meatus, affections of the Eustachian tube, of the middle ear, the nervous apparatus, are spoken of. The author's views on hereditary syphilides and such cases, due to the exanthemata, as well as those arising from intracranial affections, appear to be based more upon his subjective reasoning than upon pathologico-anatomical

experience. In conclusion, he treats of the effects of the ear-trumpet and the audiphone. In Lacharrière's hands, as well as that of other observers, the latter was found to be of no service, but he thinks that an apparatus similar to the dentaphone has a great future. This apparatus consists of a large telephone disc, which can be fastened to the head of the speaker; its connection is like that of the dentaphone.

2. CRESSWELL BAKER reports 100 cases of ear-disease which were under his care. Among the cases especially mentioned is one in which there was an objectively perceptible crackling and subjective buzzing noise in a patient who had a perforation of the membrana tympani. The objective sound was only paroxysmal.

3. KIRCHNER reports ten cases of injury of the ear which he had seen. In three cases, children, the injury was due to a box on the ear, in two of them resulting in a rupture of a healthy drum-membrane. In the third case there was a preëxisting perforation, and the insult caused a severe inflammation of the mucous membrane of the tympanum, in consequence of which the greater part of the membrane was destroyed. Two other cases occurred in adults, in which a slight injury of the drum-membrane, by a blow, caused total permanent deafness. In two other cases there was intense irritation of the labyrinth, due to the impact of loud noises (firing a pistol and the noise of a trumpet), which caused permanent deafness. In these four cases there was a whitish-gray opacity of the drum-heads which was due to a uniform infiltration. Kirchner attributes the immunity of the labyrinth to the ability of the membrana tympani to withstand shocks. In three cases of exclusive injuries of the drum-membranes there was noticeable functional disturbance. Kirchner reviews the usual methods of treatment, and emphasizes the importance of an early and careful diagnosis in injuries of the ear.

4. GUROVITSCH begins his paper by summarizing previous communications on the subject of ear-symptoms in Bright's disease, by Rosenstein, Rayer, Dieulafoy, and then proceeds to describe his own case. In a patient who had parenchymatous nephritis, based on chronic malaria, there appeared a facial œdema of the right side, with dulness of hearing and tinnitus of the right ear, in addition to a general anasarca. On examination a perforation of the drum-head was discovered, and later, furuncles of the external meatus. As soon as the œdema extended to the left side perforative otitis media set in. *Post-mortem* examination

showed swelling and thickening of the mucous membrane of the middle ear, and slight accumulation of mucus.

6. During an epidemic of recurrent fever in Königsberg, LUCHHAU noticed the frequent occurrence of ear-complications. Among 180 cases of fever there were fifteen of affections of the ear. All of these involved the middle ear, being more or less acute inflammations. The treatment in the first stages consisted in depletion of blood; in those more advanced, in paracentesis of the drum-membrane. The prognosis was not unfavorable if the case was properly treated. Pharyngeal catarrh was only observed in a single case in which there was disease of the middle ear. The tubes were always permeable.

10. CRESSWELL BAKER, who has already called attention to the presence of fungi in ear-syringes (see these ARCHIVES, vol. viii, 406), found that, in spite of the fact that the piston was greased with carbolic vaseline, after prolonged usage a new crop of fungi had formed. He now uses a syringe whose piston is made of hard rubber which can be cleaned easily.

11. POLITZER makes use of an insufflator made, according to his directions, by Leiter, out of hard rubber. It consists of a reservoir which has a lid attached to it. A tube passes through the lower half of the receiver to which another vertical tube is attached. This tube has an oval opening on one side which corresponds with another on the floor of the reservoir, and which allows the powder to pass into the horizontal tube. By turning the tube the opening is closed and the powder can be blown out.

12. ZAUFAL maintains that the light obtained by the Nitze-Leiter apparatus is next best to sunlight, and considers its introduction as a great advance in the examination of the ear. Clear, distinct images can be obtained thereby. The expense is the only objection which can be urged against it.

13. GARDINER BROWN regrets our inability to express arithmetical values when testing hearing with the tuning-fork, and now employs von Conta's method. He applies the tuning-fork to the mastoid process of the ear examined, and determines whether its vibrations are heard a longer or shorter time than in health. If, after closing the external meatus, the vibrations of the tuning-fork are not heard longer than before, there must be some difficulty of the conducting apparatus. If it is heard longer then its increased duration will correspond with the degree of obstruction.

14. CZARDA favors the use of the audiphone, but concludes by saying that its general use is attended with difficulties.

15. NORTH reports two cases of poisoning after the administration of moderate doses of chenopodium oil. The symptoms were complicated by the presence of intense deafness and noises in the ear. The former condition continued after the subsidence of the toxic effects.

EXTERNAL EAR.

17. W. MEYER, Copenhagen. The treatment of othæmatoma. *Archiv für Ohrenheilk.*, vol. xvi, pag. 161.

18. MCLEOD, Hawick. Foreign bodies in the ear. *Brit. Med. Journ.*, July 10, 1880.

19. LÖWENBERG, Paris. The parasitic fungi of the human ear. *Gazette hebdomadaire*, No 36, 1880.

20. B. TORRANCE, Newcastle-on-Tyne. Rare case of otitis externa parasitica. *Brit. Med. Journ.*, Oct. 9, 1880.

21. A. BING, Vienna. On the history of myringitis. *Wien. Med. Blätter.*, Nos. 38, 39, 1880.

22. THOS. DILLS, Fort Wayne. A case of rupture of the drum-head from a box on the ear. These ARCHIVES, vol. ix, No. 2.

17. By employing massage several times daily for 15 minutes at a time, MEYER succeeded in removing the blood-clot in two cases of othæmatoma. In one case relief was afforded in one week; the second case did not persist in the treatment after complete absorption had almost taken place. In both cases the hemorrhage was binaural, and in both, either father or mother were affected with brain trouble.

18. MCLEOD, after vainly endeavoring to remove a cherry-stone impacted in the external meatus, by means of the usual methods, succeeded in doing so by means of a small apparatus which he devised for the purpose. This consisted of a small disc of leather fastened to a string; one side of it was smeared with cement and then firmly glued to the cherry-stone. After half an hour it was so firmly adherent that traction on the string succeeded in withdrawing the stone.

19. In continuation to an address on the development of fungi in the ear, delivered before the British Medical Association at Cork, LÖWENBERG draws attention to their importance in aural and general practice. As far as the ear is concerned, he agrees with Bezold that the formation of fungi in the ear is frequently due to the introduction of fatty substances. Instead of oils he there-



fore uses glycerine. Löwenberg found that the use of decomposing solutions of astringents, etc., which contained spores and rods, was also a cause of the development of fungi. This was found to be the case on examining solutions of atropia used by oculists. He therefore suggests that it would be well to boil and filter the solutions or to keep them in concentrated forms, and when used, to add a sufficient quantity of water to dilute them as desired.

20. TORRANCE, after failing in an endeavor to remove aspergillus by a systematic cleansing and instillation of nitrate of silver, succeeded by means of a solution of chlorate of potassa, 0.1: 30.0.

21. BING describes two cases of circumscribed myringitis. In one of them, after removing a dense, adherent layer of pus, a granulating surface was found on the anterior-inferior quadrant. Cured by the application of a concentrated solution of nitrate of silver. In the other case only that part of the membrane was inflamed which was adjacent to the handle of the malleus, swelling and congestion in this region, granulations on the short process, and to all appearances there was inflammation of the cartilaginous structure of the malleus. Treatment consisted of applications of the sesquichloride of iron and insufflations of alum.

#### MIDDLE EAR.

23. H. A. SPENCER, St. Louis. The dry treatment in suppuration of the middle ear. *American Journ. of Otology*, vol. ii, pag. 184.

24. JOS. GRUBER, Vienna. On some new methods of treating otorrhœa. *Allg. Wien. Med. Zeitung*, Nos. 28, 29, 1880.

25. A. POLITZER, Vienna. On the treatment of aural polypi. *Wien. Med. Wochenschr.*, No. 31, 1880.

26. SWAN M. BURNETT. A case of primary external mastoiditis. These ARCHIVES, vol. ix, part 2. p. 145.

27. F. C. HOTZ, Chicago. Abscess of the postauricular region without disease of the middle ear. These ARCHIVES, vol. ix, p. 250.

28. F. C. HOTZ, Chicago. The indications for an early trepanation of the mastoid process in acute purulent otitis media with implication of the mastoid cells. These ARCHIVES, vol. ix, No. 2, p. 156.

29. F. C. HOTZ, Chicago. Aural complaints in consequence of malaria. These ARCHIVES, vol. ix, No. 3, p. 241.

30. REYNOLDS. Perforation of membrana tympani from ascaris lumbricoides. *The Lancet*, Oct. 23, 1880.

31. ROOSA and ELY. Clinical contributions to otology. These ARCHIVES, vol. ix, p. 16.
32. FRANK ALLPORT. A case of probable abscess of the brain. *The American Journal of Otology*, vol. ii, page 189.
33. EDGAR A. BROWNE, Liverpool. A modified inflator for the middle ear. *The Lancet*, Aug. 14, 1880.
34. D. B. ST. JOHN ROOSA. A new ear douche. These ARCHIVES, vol. viii, p. 355.
35. J. GRUBER. On the therapeutic value of injections of medicated solutions into the Eustachian tube. *Monatsschr. f. Ohrenheilk.*, No. 9, 1880.
36. CLARENCE J. BLAKE. Manometric cicatrix of the membrana tympani. *The American Journal of Otology*, vol. ii, page 201.
37. ALBERT H. BUCK. Unnatural patency of the Eustachian tube. *Ibidem*, p. 203.

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23. SPENCER recommends the dry treatment in the second stage of acute purulent otitis media after perforation. The ear is cleansed by means of absorbent cotton, both before and after using Politzer; after this a tampon should be inserted which reaches to the drum-head. No air is allowed to reach the affected parts, and by absorption of the discharge the healing is favorably influenced. Several cases are reported in which, under this method, a rapid recovery ensued.

24. When using caustic solutions of nitrate of silver, GRUBER takes care that no more of the fluid be applied than the case absolutely requires. In order to prevent its exit through the tubes, the head should be bent backward and toward the other side. This treatment is contra-indicated in caries and polypoid growths. If alcohol be used, the duration of treatment will generally be longer than when nitrate of silver is the agent employed. The boracic-acid treatment is better than any of the older methods.

25. POLITZER recommends the use of alcohol for the removal of granulations and polypoid excrescences. This is to be poured into the ear and allowed to remain for from 10-15 minutes. At first these instillations are to be made three times daily; later, only once a day. If there be great pain the alcohol can be diluted with an equal quantity of water. The continued use of alcohol will effect atrophy not only of the soft polypi, but also of the tough, dense fibromata. Politzer reports several cases in which the usual

methods proved of no avail, but which were cured by the use of alcohol. The effect is almost certain, and is not liable to do any harm. The fact that it can be applied by any physician is also an advantage.

The application of alcohol is indicated in all cases of granulations and polypi which cannot be removed by operative measures, and where it is desirable that no surgical interference should be resorted to.

32. The "probable" cerebral abscess, which was "perhaps" due to an acute otitis media, occurred in a man who, during the progress of an acute otitis media, exposed himself repeatedly to inclement weather. The exposure was followed by neuralgic headaches and, later, by severe meningeal symptoms, without any recurrence of the ear-symptoms. After a sudden ejection of creamy pus from the nose, the patient died comatose. ALLPORT was not permitted to make an autopsy.

33. As, during forced expiration through the mouth, the nasal cavity is completely shut off from the pharynx by the soft palate, BROWNE suggests that in children the inflation of the ears should be done as follows: a small tube, which is connected by means of a bit of rubber tubing with Allen's nasal attachments, should be put into the child's mouth, and it should be taught to blow into its nasal cavity itself.

35. GRUBER gives us his views upon the therapeutic value of medicated injections into the Eustachian tube. They are in accordance with those generally accepted. Accumulated mucus is not dissolved by the injected fluids, but is softened and can then be more easily removed. They also are of benefit by producing a new inflammatory condition. Gruber believes that synechiæ, extending from the sides of the tympanum to either the drum-head or the ossicula, can be detached by means of injections, even though the air-douche proved of no avail. These injections can be made either through a catheter or by closing one nostril and forcing the fluid through the other canal.

36. BLAKE describes a case in which synchronous movements during respiration were observed in a cicatrix of the drum-head. During phonation they were hardly noticeable. In this, as in two other cases previously reported, the cicatrix was situated in the anterior portion of the drum-head, opposite the orifice of the Eustachian tube.

37. BUCK describes two analogous cases. In the first one

there was an oval cicatrix in the posterior-inferior quadrant showing depressions and elevations during respiration. On applying Valsalva's method there was decided bulging of the cicatrix, which collapsed as soon as the inflation ceased. In the second case the entire membrane was atrophic, probably reformed after an otorrhœa during childhood. The movements of the membrane were only observed during deglutition. We can hardly endorse Buck's opinion that in this case there was an abnormal patency of the tube. This should have been determined by means of the manometer.

NERVOUS APPARATUS.

38. D. B. ST. JOHN ROOSA, New York. The syphilitic diseases of the inner ear. These ARCHIVES, vol. viii, p. 336.

39. LADREIT DE LACHARRIÈRE. The effects of the constant current upon certain affections of the inner ear. *Annal. des Mal. de l'Oreille*, etc., No. 4, 1880.

40. V. URBANTSCHITSCH. Observations on central affections of the acoustic nerve. *Archiv f. Ohrenheilk.*, vol. xvi, p. 171.

41. BÆLZ and KAWAKAMI. The Japanese flood-fever; an acute, infectious disease. *Virchow's Archiv*, vol. lxxviii, pag. 373, 421, and 528.

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39. LADREIT DE LACHARRIÈRE believes that the sympathetic nerve exerts a greater influence upon the ear than is generally supposed. Many disturbances can be traced to changes in the vaso-motor innervation, which give rise to acute and chronic affections of the ear, combined with pathological changes in the digestive and female genital apparatus. He thinks that these are mainly due to paralytic vaso-motor congestions, and that the contractility of the vessels would be increased by the constant current. Two cases are briefly reported in which this treatment effected a cure. In reviewing the previous applications of electricity, only Bonnafont's and Duchenne's names are mentioned. Lacharrière introduces the electrodes into the external auditory canals, and deems it of great importance that the current should pass through the base of the brain.

40. The first case described by URBANTSCHITSCH was that of a hysterical woman who, in conjunction with other troubles, suffered from periodical attacks of vertigo, and subjective noises of the ear, and headache. In one ear there was total deafness; in the other,

hyperæsthesia. When a horse-shoe magnet was placed near the mastoid process of one side, the deafness passed to the hyperæsthetic side, and *vice versa*. This transfer occurred regularly, at first for the high tones, and afterward for the deep ones. A deep murmur, which was heard on the hyperæsthetic ear, became weaker with the beginning of the transfer, then disappeared, and after this only did the transfer of the tones set in. After the lapse of about six minutes, all these symptoms returned suddenly in the same rotation as they disappeared. Urbantschitsch thinks that there was no simulation. A constant current of 40 cells produced no reaction on sight or hearing on the hyperæsthetic side; after transfer they again appeared, combined with intense vertigo. When a tuning-fork or a piece of paper was used instead of the magnet, a transfer also set in. After further experiments, Urbantschitsch noticed that there was an automatic repetition of the transfer after a single application of the magnet, but unless the magnet had been previously applied, neither tuning-fork nor paper would answer. The reaction of the pupil was more sluggish on the anæsthetic side than on the other.

The second case was that of a syphilitic patient, who lost his hearing after catching cold. Although the voice was not heard, the ticking of a watch was unusually audible to him. There was no disturbance of equilibrium, nor was there nausea or vomiting. For this reason Urbantschitsch does not believe that there was any considerable labyrinthine affection. There were noticed forgetfulness, sleepiness, headache, and also paleness of both optic nerves, and specific choroiditis. The deafness due to some central lesion. Specific treatment effected a cure.

In the third case, a slight blow on the forehead of a child was followed by severe epistaxis and disturbances of equilibration, and a week later by binaural deafness. Urbantschitsch attributed the deafness here also to some central disturbance.

The fourth case was that of sudden binaural, total deafness after profuse epistaxis. *Post-mortem* revealed no cause for the above.

41. The disease described by BÆLZ makes its appearance annually, during the months of July and August, in certain districts which have been overflowed during the previous spring. It appears as an acute, non-contagious, infectious disease, with a typical febrile course; it begins with circumscribed necroses of the skin, and passes on to an enlargement of the lymphatic glands, etc.; the

ear is also affected. The most striking symptom is deafness, which is mainly of a non-inflammatory order. There is no pain, nor any disease of the nares or pharynx, nor any otorrhœa. The deafness sets in when the fever is at its height, and sometimes becomes intense; it lasts until convalescence sets in, gradually disappears, and leaves no traces behind. It is difficult to decide whether this is due to some labyrinthine affection, which disappears spontaneously, as in typhus fever, or whether it is due to the cumulative effects of the administration of quinine in large doses.

#### NOSE AND NASO-PHARYNX.

42. WEIL, Stuttgart. On diseases of the nose and the naso-pharynx, with demonstration of instruments and specimens. *Würt. Med. Correspondenzbl.*, No. 38, 1880.

43. G. JUSTI, Idstein. The use of dilators in diseases of the nasal cavity and the naso-pharynx. *Wien. Med. Wochenschr.*, No. 29, 1880.

44. G. JUSTI, Idstein. Indications for and application of the curette in growths of the nasal cavity and the naso-pharynx. *Ibidem*, No. 38, 1880.

45. ROTH, Vienna. Removal of a tumor, the size of a pigeon's egg, from the naso-pharynx. *Ibidem*, No. 30, 1880.

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42. WEIL briefly reviews all the diseases of the nose and naso-pharynx. We note his treatment of acute catarrh. When the catarrh begins with tickling of the throat he tries to cut it short by insufflations of boracic acid. In chronic catarrh he applies a ½-per-cent. spray of nitrate of silver, and also the galvano-cautery. Gottstein's cotton-tampons are recommended for ozæna. The author showed a specimen taken from a deaf-mute, aged 3½ years. "The entire naso-pharynx is filled with adenoid growths; Rosenmüller's fossa and the orifices of the Eustachian tubes not visible; the tubes can only be found with great difficulty. Examination of the ear shows great retraction of the drum-head and dryness of the tympanic cavity. The joints of the chain of bones are apparently intact, but the left incus is entirely detached from the stapes [artificially (?) Reviewer]. Both the long process of the incus and the posterior arch of the stapes are adherent by a dense band to the promontory. Nothing abnormal found in the labyrinth.



43. In stenosis of the nasal passages, due to hypertrophy or neoplasms, JUSTI effects dilatation by means of tents; first using laminaria, which remains in situ for thirty hours. After that a sponge tent is introduced, which must remain from fifteen to twenty hours. In a case of syphilitic disease of the nose, with granulations and caries, Justi succeeded in dilating the anterior two-thirds of the passage in such a manner that he was able to remove granulations and carious bone by means of the sharp spoon, and thus effect a cure.

44. JUSTI has operated thirty times in the naso-pharynx with the sharp spoon, and twenty-six times a single sitting sufficed to remove all excrescences from the cavity. He has employed this method with a child of three months. Justi advises the use of the sharp spoon for the removal of polypoid hypertrophies of the nasal mucous membrane and for mucous polypi (!).

45. ROTH found a tumor larger than a pigeon's egg in the naso-pharynx of a patient, which filled the cavity and originated from the lower border of the left fossa. He endeavored to pass a loop around the growth, but failed until he secured it by means of a hook attached to a string, and then passed this through the wire loop. The tumor was severed by means of the galvano-cautery. Roth was surprised that the cautery caused an inflammation of the mucous membrane, which endured for more than four weeks.

Fig. 1



Fig. 2

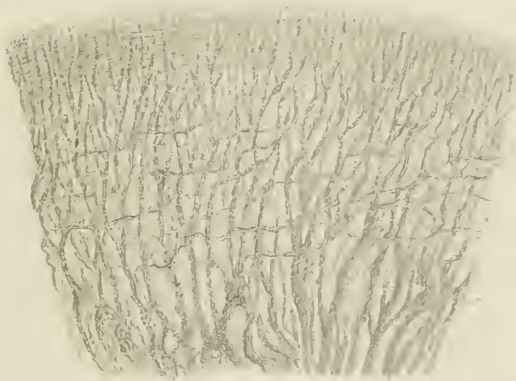


Fig. 5

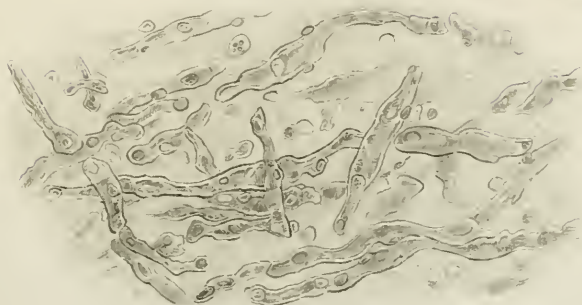


Fig. 3

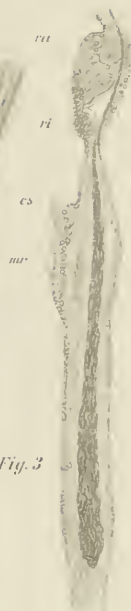


Fig. 4



Fig. 6

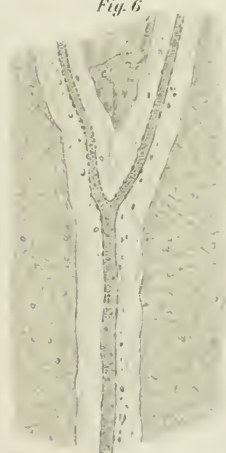
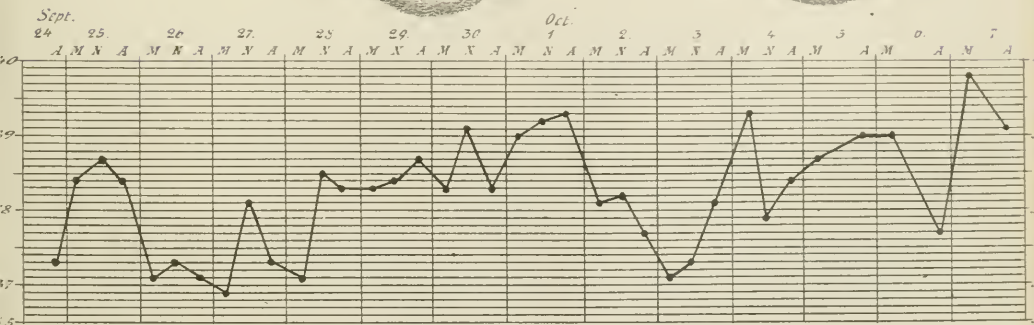
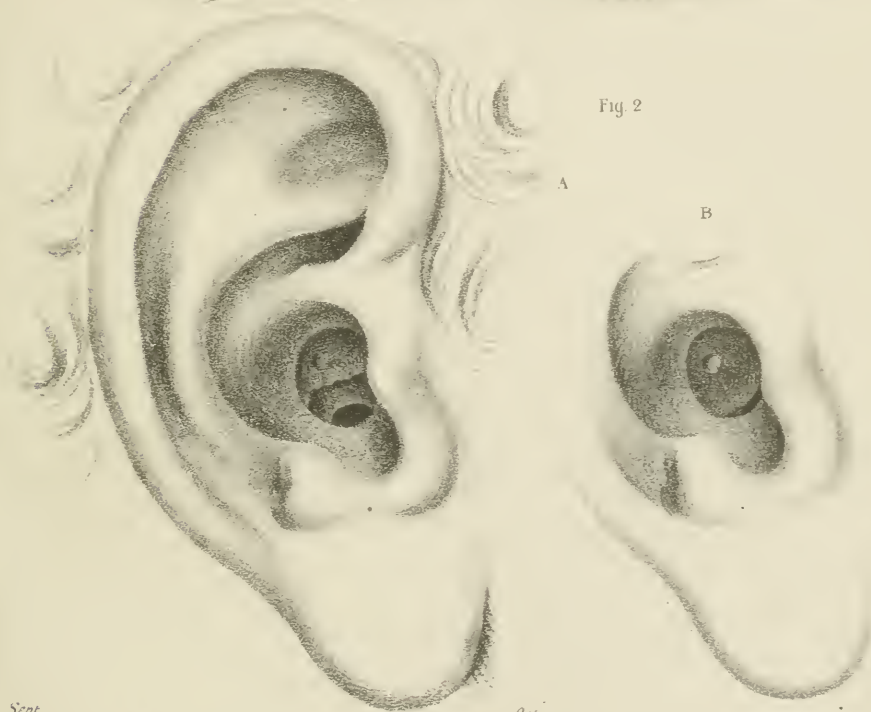




Fig. 1



Fig. 2





# ARCHIVES OF OTOLOGY.

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## AN OPERATION FOR PROMINENCE OF THE AURICLES.

BY EDWARD T. ELY, M.D., OF NEW YORK.

*(With two wood-cuts.)*

The patient was a boy, aged 12, who came to the clinic of Dr. Roosa and myself at the Manhattan Eye and Ear Hospital, complaining that his companions ridiculed him on account of the prominence of his ears. He had this common deformity of the auricles to a somewhat unusual degree.

On March 1, 1881, I operated upon the right ear as follows: An incision was made through the skin, along the entire length of the furrow formed by the junction of the auricle with the side of the head posteriorly. This was joined at each end by a curved incision carried over the posterior surface of the auricle, and the skin and subcutaneous tissue included by these incisions were dissected off. Two incisions, nearly parallel to the former ones, were then carried directly through the cartilage, and an elliptical piece of the latter, measuring  $1\frac{1}{8}$  in. by  $\frac{1}{3}$  in., was removed. The piece of excised skin was considerably larger than this. The edges of the wound were then united by 10 sutures, of which 7 included only the skin, while 3 passed through both skin and cartilage. Owing to the natural folds of the cartilage, it was impossible to secure perfect coaptation on the anterior surface of the auricle, and a small space was here left to heal by granulation. The dressing consisted of absorbent cotton and a bandage. Healing ensued without accident. There was no pain and very little swelling. The posterior incision united by first intention, and the anterior wound healed rapidly by granulation. The sutures were removed on the fourth day.

The operation upon the left ear was performed on April 19th. Holding the auricle so that the light from a window shone through



it, I transfixed it with the scalpel, and rapidly excised a piece of cartilage of the desired size and shape, together with its overlying skin. Additional skin was then removed from the posterior surface, until the wound seemed to correspond in extent to that made at the former operation. Twelve sutures were used, of which three were passed through the cartilage on its anterior surface and one on its posterior surface, while the others were passed through the skin only. The dressing was the same as before, and, excepting the fact that complete union by first intention was not obtained behind, the healing was equally satisfactory. I did not like this plan of operating, however, as well as that first employed. Ether-anæsthesia was used on both occasions.

It was very interesting to observe how well these wounds of the cartilage healed. The position of the auricles is now (June 1st) all that could be desired. The posterior cicatrices are hidden by their position, and those on the anterior sur-



FIG. I.

face are hardly noticeable. No change in the hearing, which was normal, has been observed. The accompanying woodcuts are copied from photographs taken after the first operation. They will serve to show the position of the auricles before and after this treatment.

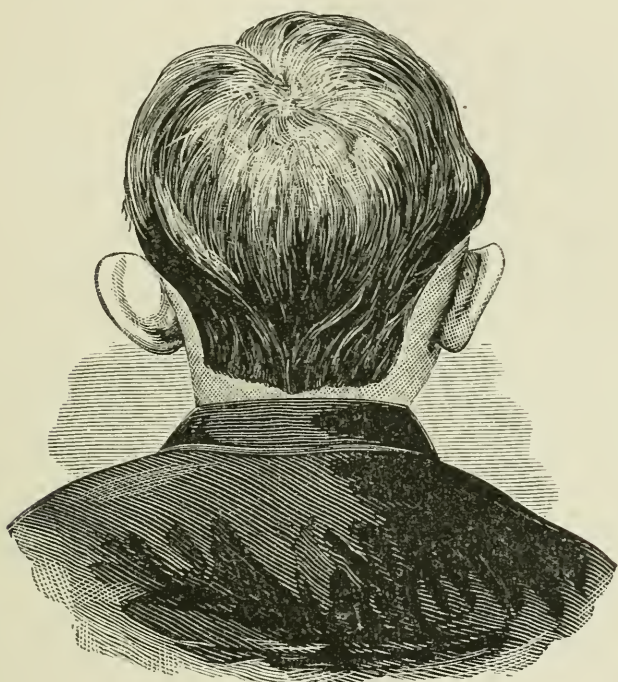


FIG. 2.

I do not know whether this is a new operation for the deformity in question or not, but, if allowed to judge from a single case, I can highly recommend it. Before operating, the hair should be shaved from the neighborhood of the ear, and the meatus stuffed with cotton to prevent the entrance of blood.

ANATOMICAL AND CLINICAL CONTRIBUTIONS TO  
THE KNOWLEDGE OF THE DISEASES OF THE  
NASO-PHARYNGEAL REGION AND THE  
EAR IN CONSUMPTION.

BY DR. EUGENE FRÄNKEL, OF HAMBURG.

Translated by Dr. F. E. D' OENCH, of St. Louis, Mo.

ALTHOUGH our knowledge of the pulmonary diseases leading to consumption, and of the organs generally affected by them, may now be considered almost complete, it is still defective in regard to some organs, and parts of the body. This may be accounted for partly by the difficulty attending the examination of these organs, partly by the lack of attention bestowed upon them, though Wendt (*v. Ziemssen's Handbuch der Krankheiten des chylopoëtischen Apparates*, Bd. i, 1, 2te aufl., 1878, p. 246) and, later, Schalle (*Virchow's Archiv*, vol. lxxii, 2) described a method of greatly reducing these difficulties; nevertheless, this method was not taken advantage of, and to cast some additional light on the diseases of this region is, therefore, the object of this paper. The title I have chosen may need some explanation. In studying the morbid changes in this locality, I confined myself to consumptives, noting every morbid change, even those which undoubtedly cannot be ascribed to phthisis; the title chosen may, therefore, not seem entirely justifiable, but it is my belief that at least one-half of the morbid changes to be described are due to phthisis.

The results described are based upon the *post-mortem ex-*

aminations of 50 consumptives, selected without regard to age, sex, or duration of the disease, from the whole number of those who had died of phthisis within a period of about four months.

The anatomical changes in the lungs were due, in by far the greatest number of cases, to disseminated, fibrous, or caseous peribronchitis; in a few instances to tuberculous peribronchitis, caseous broncho-pneumonia, or desquamative pneumonia; sometimes to cirrhosis, or caverns of varying size and age (combinations of these different forms were, of course, not infrequent); obliterations of the pleura, sometimes partial, sometimes total, on one or both sides, often gave rise to complications. Most cases had taken a chronic course; there were only a few of acute disseminated peribronchitis, and none of acute miliary tuberculosis. Death had been caused in some instances by recent pleuritis, pneumothorax or perforating peritonitis, due to tuberculous ulcers of the intestines; every body was highly emaciated. In 8 cases the larynx was affected, in 21 the intestines, in 14 both larynx and intestines, in 7 the destructive processes were confined entirely to the lungs.

Of the whole number of cases 36 were men, 14 women; there were none under 10, 2 between 10 and 20, 14 between 20 and 30, 17 between 30 and 40, 15 between 40 and 50, 1 between 50 and 60, and 1 between 60 and 70.

The method of examination was as follows: After removing the parts of the base of the skull in question, according to Schalle's method, they were sawed through in a sagittal direction on both sides of the septum narium, then the cavity of the tympanum was opened, the semicircular canals were examined, and, finally, the cochlea and vestibule were *exposed*. In this manner all the parts in question can be carefully examined, and, owing to the small number of sections, can easily be reunited and used for demonstrations; sometimes it is advisable to remove the floor of the nasal cavity by a horizontal section, leaving only a narrow bridge to connect it with the neighboring parts.

Of the specimens obtained in this way, morbid changes were found in 29 of them in the naso-pharyngeal region or

the auditory organs; the nasal cavity and inner ear, however, did not share in them. Tuberculous affections of the nasal cavity, as is well known, are rare, only a few cases having been described so far, by B. Fränkel (*v. Ziemssen's Handbuch*, 1, p. 137), who published the case observed by Willigk, by Laveran (*Union Méd.*, 1877, No. 35), by Riedel (*Deutsche Zeitschrift für Chirurgie*), and by Tornwald (*Deutsches Archiv f. Klin. Medicin*, Bd. xxvii, H. 5 and 6, p. 588). In none of my 50 cases did I find any tuberculous affections, and, therefore, in opposition to Tornwald, believe that they are very rare in the nasal cavity. On some other occasion, however, I shall describe the case of a boy, five years old, who had died of tuberculous pleuritis and amyloid degeneration, following resection of the head of the right femur, where I found miliary tubercles on the mucous membrane of the septum narium; caseous otitis, accompanied by the formation of several sequestra, had set in, and a number of tubercles had formed on the mucous membrane of the septum, on a line with the left middle meatus, every one of which was surrounded by a delicate wreath of blood-vessels; there was a strong fetid odor.

Of these 29 cases 10 were confined to the naso-pharyngeal region exclusively, all of them being ulcers, frequently involving the *pharyngeal ostium of the Eustachian tube*, and sometimes penetrating to the rough surface of the basilar process of the occipital bone. Men and women were equally often affected; 6 were between 20 and 30, 1 between 30 and 40, 2 between 40 and 50, and 1 between 50 and 60; only once neither the larynx nor the intestines were affected; in 5 cases there were ulcers in both, in 4 in the intestines, and in 1 in the larynx alone. This confirms the observation of Wendt and Wagner (*l. c.*, p. 302), who frequently found ulcerations in the naso-pharyngeal region, associated with ulcers in the intestines.

As regards the location of the ulcerations, it is notable that in eight of the ten cases the tonsil was affected; in the other two they were confined to the *region of the orifice of the Eustachian tube*; in four cases the mucous membrane of the latter region, on both sides, as well as of the tonsil,



had ulcerated, once only on the left side ; in three of these eight cases, *the orifice of the Eustachian tube* was not affected. The auditory organs remained intact in every case, even when ulcerations had formed at the entrance to the Eustachian tube ; this is the more remarkable, because in other diseases of the naso-pharyngeal region secondary changes in the auditory organs are not rare, for instance when otitis media has resulted from adenoid growths in the pharynx.

These observations agree with those of the investigators mentioned above, Wagner and Wendt, who found that in several cases of large ulcers of the tonsil the middle ear remained either entirely intact or was affected only on one side.

The form of the ulcers varied ; in general those extending to the Eustachian tubes or the posterior wall of the pharynx were confined to the upper strata of the mucous membrane, while the more circumscribed ulcers near the tonsils presented a crater-like appearance, and in two cases had laid bare the bone. Tuberculous eruptions, either with or without exudation, were entirely wanting. Nevertheless, I would invite clinicians and anatomists to search for ulcerations in the roof of the pharynx in those cases of phthisis in the course of which symptoms of tuberculous meningitis have developed, in order to determine whether or not any connection can be established between them.

In the great majority of cases the ulcers appeared more or less unclean, uneven, partly covered with disintegrating growths resembling granulations, partly with yellowish-brown nodules of the size of a pin-head, here and there also with punctiform ecchymoses, while a dirty, puriform, greenish-yellow viscous secretion overspread their surface ; the edges of the ulcers frequently presented a ragged appearance ; in some cases they were lined with the grayish-yellow nodules just mentioned, which sometimes, when the ulcers themselves were free from them, appeared in the surrounding tissue ; frequently the ulcers were undermined to a considerable extent.

Besides the ulcers just described lesions of the mucous



membrane at or near the mouth of the Eustachian tube were sometimes found, which, on account of their shallow, circular shape and sharp edges, very much resembled the laryngeal ulcers of consumptives.

Besides the nodules mentioned above, hemorrhages were observed in the neighborhood of the ulcers, and also, though very seldom, cicatricial cords, presenting a very curious appearance, due to the net-like manner in which they interlaced. In two cases, the mucous membrane looked as though it were worm-eaten, an appearance due to the pores of the distended ducts of the numerous racemose glands. Here and there a few small cysts were noticed.

In order to gain an insight into the development of these ulcerations, I examined a few where tubercles could be suspected, with the microscope, without, however, being able to find any, though Wendt saw them in two cases on the border and in the neighborhood of the ulcers. Though the formation of ulcers from the disintegration of tubercles must therefore be granted in a few cases, it is certainly a very rare occurrence, and so I would give for many of them the following explanation:

The changes found consisted in a very dense infiltration of cells and nuclei, sometimes diffuse, sometimes more circumscribed, and of about the size of two or three glandular acini; sometimes it was confined to the layers nearest the epithelium, sometimes it extended in between the glands, surrounding the numerous small blood-vessels of the sub-epithelial layer and the distended ducts of the glands.

In some places the epithelium of the ducts still remains, in others it is missing, while dense masses of cells and nuclei fill the duct; the glands themselves appear intact, only here and there an interlobular infiltration is visible. The calibre of the blood-vessels within this zone is partly very much reduced, partly obliterated by compression. Beyond the layer of the glands there is no sign of this infiltration. Judging from this condition it, therefore, seems probable to me that in consequence of the compression of the blood-vessels necrobiotic processes are brought about, the emigrated blood-corpuscles disintegrate, the epithelium is de-

stroyed, and finally ulcers are formed, the depth of which depends upon the extent and character of the infiltration. As regards the development of these shallow lesions which sometimes occur on the mucous membrane of the orifice of the Eustachian tube, I have not arrived at any definite explanation. It is not quite clear what Wendt and Wagner (*l. c.*, p. 303) mean by the follicular origin of some of the ulcers examined by them, whether they are due to the caseous degeneration of the numerous lymph-follicles of the mucous membrane, or whether they have an origin similar to that of the follicular ulcers developing in the larynx and trachea of consumptives out of the ducts of the mucous glands of these organs.

That these ulcerations can heal has already been stated by Wendt and Wagner and is proved by the cicatricial tissue in their neighborhood, a fact which cannot seem strange when we take into consideration that we find cicatrices associated with fresh ulcers in organs which, like the larynx and intestines, are the favorite seat of tuberculous affections. I cannot, therefore, agree with Michel ("Die Krankheiten der Nasenhöhle und des Nasenrachenraumes," Berlin, 1876), who attributes all more extensive ulcerations of the nasopharyngeal region to syphilis.

Before entering on the discussion of my clinical observations, I wish to refer briefly to the origin of the small cysts mentioned above, which I found not only in the nasopharyngeal region, but also in the antrum of Highmore, of varying size and number, and frequently unattended by any ulcerations; while I agree with the explanation given by Wendt and Wagner (*l. c.*, p. 268 ff.) of their development, I will only add that in the cases which I examined they were retention-cysts, due to compression of the ducts of the racemose glands by the cellular infiltration of the subepithelial layer, thus preventing the discharge of their secretion; in a few cases the contents had suppurated and the membrane had become so thin that even a slight pressure was sufficient to burst the cyst. Of course, the same result might take place spontaneously, for instance, from very rapid growth, thus giving rise to a lesion which, in turn, might develop into an ulcer.

In regard to the time of appearance and subsequent course of these ulcerations, I can say the following: 1. They are sometimes found when only slight changes can be detected in the lungs, although they generally accompany the later stages of phthisis; or 2, they may remain latent and are only discovered by the *post-mortem* examination, though sometimes the painful sensations caused by their presence constitute the chief grounds for complaint. I remember, for instance, the case of a young book-keeper, 24 years old, where, in addition to tuberculous ulcerations of the epiglottis, there was a deep, crater-like ulcer near the tonsil, which was the cause of constant complaint. He continually had the sensation of mucus adhering to this spot, causing him to *hawk* violently; a crust formed at night, which could only be removed with great difficulty. Months later caseous degeneration and ulceration of the solitary follicles of the posterior wall of the pharynx set in, considerably intensifying the sufferings of the patient, and rendering the last months of his existence particularly painful. He frequently complained of a pricking pain in both ears, a symptom which I consider to be due, in many cases, to ulcerations in the naso-pharyngeal region, and not, as is generally assumed, to tuberculous ulcers of the pharynx, or lesions of the larynx, especially the posterior wall; in this I agree with Traube, who, in his "symptoms of the diseases of the respiratory organs," ascribes the pain often felt in the ear by consumptives, to ulcerations in the neighborhood of the orifice of the Eustachian tube. This is proved by those cases in which, although no ulcerations can be found in the larynx or pharynx, the patients complain of pain in the ears, and an examination with the rhinoscope reveals ulcers in the naso-pharyngeal region, especially at the *ostium tubæ*; yet I will not deny that cases occur, in which just the reverse of the morbid changes mentioned exists, to which the explanation of Fränkel, given in his paper "on tuberculosis of the pharynx" must be applied (*Berl. Klin. Wochenschr.*, Nos. 46 and 47, 1876). He ascribes the pain to perverse sensations conducted through Jacobson's and the glosso-pharyngeal nerve. In a third series of cases the ex-

amination of the auditory organs themselves gives a sufficient explanation, (to which I shall recur later,) at the same time it indicates the treatment to be resorted to.

In regard to the differential diagnosis of these ulcers I agree with Fränkel, "that the appearance of the ulcers is sufficiently characteristic to make a diagnosis," he states this to be true of the ulcers found in the pharynx of tuberculous persons, while I claim that it is also true of those of the naso-pharyngeal region, not only in the living, but also in the dead subject.

In treating these ulcers I would recommend a 1-per-cent. solution of creosote dissolved in equal parts of alcohol and glycerine. It is a preparation frequently used in Dr. Bülow's wards in cases of painful tuberculous ulcers of the larynx and pharynx, which often afforded at least temporary relief; I sometimes also applied absolute alcohol, or made use of hypodermic injections of a 2½-per-cent. solution of carbolic acid, which, applied at the angle of the jaw, caused the pain to disappear rapidly.

I shall now proceed to describe those changes which had taken place in the auditory organs. They were found diseased in 16 cases: 8 of which were complicated with affections of the naso-pharyngeal region. The other eight were confined to the auditory organs alone. Beginning with the latter, it is a curious fact that all were men, the youngest being 26, the oldest 68 years old; while three were between 40 and 50, one a little over 30, and two almost 30. In the great majority of cases, a *direct* connection can hardly be found between these morbid changes and the phthisis itself; in only two cases I consider it *possible* to speak of such a connection, though even for them I would not make any positive statements, because it remained uncertain whether phthisis had developed sooner than the morbid processes in the ear, or *vice versa*. In both cases extensive changes in the mucous membrane of the cavity of the tympanum, combined with caries of the walls, had taken place, especially in the case of a young man of 26. The drum-head of the right ear, which was the one affected, was entirely destroyed, while beyond it a bowl-shaped cavity ex-

tended, reaching from the mastoid cells to the orifice of the Eustachian tube; the ossicles were gone. A narrow strip of mucous membrane still existed on the floor of this cavity; in the remainder of it the roughened bone lay exposed; near the orifice of the Eustachian tube a sequestrum projected, still firmly attached. The whole vestibule was destroyed, the bone converted into a sandy mass, the facial nerve gone from its first inflection to its point of emergence at the stylo-mastoid foramen, and the cochlea was exposed with all its turns. The case of phthisis had been a very severe one, the pulmonary tissue had been destroyed to a great extent, cavities had formed, and there were ulcerations in the larynx and intestines.

Such extensive morbid changes in otherwise healthy persons being but very rarely caused by a purulent otitis media not dependent upon a dycrasia, it seems very probable to me, that, as this was not a primary tuberculous ostitis of the petrous portion of the temporal bone, although the existence of such an affection was put beyond doubt by Zaufal and others, it was a caseous inflammation of the mucous membrane of the tympanic cavity, "speedily followed by ulceration and degeneration of the mucous membrane. . . and sometimes by caries of the bone" (Schwartz, *Pathol. Anatomie des Ohres*, 1878, p. 80). In the second case also, that of a young man of 24, the right ear was the one affected; the drumhead, with the exception of a narrow crescent on the roof of the auditory canal, had been destroyed, caries of the wall of the labyrinth below and behind the promontory had begun to the extent of a pin's head, and all the ossicles were gone, while the vestibule and cochlea had remained intact. The destructive process in the lungs was mainly confined to the right side; the larynx and intestines were normal.

Such extensive destructive changes as in the first case just described, could only be wrought in the course of months, so that both the ear and lungs may have become affected at the same time, or the former may even have been the starting-point for the phthisis which afterward developed in the lungs. See also v. Troltsch (3d ed., 1867, p. 337, note),



and Urbantschitsch (*Lehrbuch der Ohrenheilkunde*, 1880, p. 370), who discuss the possibility of tuberculosis developing in connection with chronic purulent otitis media. I also observed a case of this kind about three years ago.

The case was one of a young merchant without any hereditary taint, who, in the fall of 1877, became affected with purulent otitis media, which would yield to no treatment, and greatly reduced the patient, especially through the great pain which he suffered at night. Nothing abnormal could be detected at the time in any other organ, especially the lungs; the otorrhœa was more or less profuse, and never ceased entirely; in the spring of 1878, a periproctal abscess formed, after the incision of which an incomplete external fistula of the rectum remained, which, however, after being operated, healed, though very slowly; in the meantime a cough began to trouble him, morbid changes in the apex of the lungs were discovered, tuberculosis of the intestines and ulcers of the larynx followed, and in the spring of 1879 the patient died.

Undoubtedly the phthisis of this case, was in direct connection with the purulent otitis media, and it would be of interest to know how frequent such an occurrence may be. Of course this would involve the examination of the auditory organs of every consumptive, and, when a purulent otitis media exists or has existed, the determination of its duration and its connection with the general disease.

Of the remaining six cases, four were due to a mucous (left-side) and (once) a muco-purulent (right-side) catarrh of the middle ear; twice sclerosis had begun in the tympanic cavity, which had given rise to the formation of thread-like pseudo-ligaments, partly between the ossicles themselves, partly between them and the wall of the labyrinth; the drumhead had remained uninjured, but appeared somewhat opaque; whether or not the hearing was impaired I do not know, as no tests were made, which, besides, would have no bearing on this question.

I have already stated that I do not think that any direct connection exists between these local affections and the primary disease, still, I wish to define my position more accurately, in so far as I am in complete accord with v.



Troltsch (*l. c.*, p. 242) in thinking that *phthisis predisposes to the development both of an otitis media sicca and mucipara*. In proof of this I can cite the results of my examination of the auditory organs of non-consumptive persons, where sclerosis of the middle ear was rarely found.

It now but remains to consider the last category of cases, in which both the naso-pharyngeal region and the auditory organs were affected. Here, also, most of the cases were those of men, only one of the whole number (eight) being a woman. One was between 10 and 20, two between 20 and 30, one between 30 and 40, and four between 40 and 50 (a woman among the last). Three were cases of otitis media with sclerosis, four of catarrh, and only one of purulent otitis media.

The last-mentioned case was one of a man 42 years old, who had died of caseous peribronchitis of both lungs, combined with cavities in the right upper lobe and tuberculous ulcers of the intestines, and who, during life, had complained of pain in the right ear when swallowing. Larynx and pharynx were found normal; there were no ulcerations in the naso-pharyngeal region, the mucous membrane of which was of a scarlet-red and infiltrated with numerous ecchymomata. The drumhead in the right ear was entirely destroyed, the floor and inner wall of the tympanic cavity covered with creamy pus, below which lay the rough bone of the wall of the labyrinth; the circulation between the hammer and anvil was imbedded in a jelly-like, viscous exudation; of the malleus there remained only the head and short process, and a piece of the handle about 1-2 mm. long; of the incus, the body and a piece of the short process; while the stapes was gone entirely.

In regard to the connection in this case between these morbid changes in the ear and the general disease, I hold the same opinion as in the case of purulent otitis media, complicated with caries of the wall of the labyrinth, which I described above, although in the absence of a history I have no sufficient proofs for this.

In the three cases of dry otitis media combined with the formation of numerous synechiæ (twice in the left ear, once

in both), the changes in the naso-pharyngeal region consisted twice in the presence of cysts in Rosenmüller's fossa or the tonsil respectively, and once in spotted extravasations of the roof of the pharynx; in the first two cases the general disease was confined to the lungs, in the last the larynx and intestines were also affected.

The remaining four cases were catarrhs of the middle ear; twice affecting both ears, and once the right, and once the left alone; in only one case (where both ears were involved) the drumhead had been destroyed. The morbid changes in the naso-pharyngeal region consisted in two cases in cicatricial bands: once in Rosenmüller's fossa, and once at the roof of the pharynx, between which the mucous membrane had sunken in; while in the two other cases ulcers had formed, one of which, of crater-like shape and situated near the tonsil, had penetrated to the bone, while the other extended as far as the orifice of the Eustachian tube on both sides. It is not improbable, therefore, that, judging from these conditions, these processes are directly connected with the coexistent changes in the auditory organs.

Aside from the functional changes, which very probably existed in every one of the 16 cases, subjective symptoms in form of pain were manifested in only one case, so that there were no indications for treatment of the aural affection; the nature of the treatment would be regulated by general principles, and need not be enlarged upon.

In conclusion, three cases remain to be reported, which were confined to the naso-pharyngeal region; retention-cysts of about the size of a bean had formed, twice in the neighborhood of the tonsil, and once near Rosenmüller's fossa, and although I do not think that any connection existed between them and the primary disease, still they may be of importance in deciding the question in regard to the frequency and nature of the idiopathic as well as secondary morbid changes of the naso-pharyngeal region, which sometimes are associated with certain general diseases. In two of these cases (men of 23 and 31) ulcerations of the larynx and intestines had formed in addition to the destructive

processes in the lungs; in the third (a woman of 43) there were also ulcers of the intestines.

The total number of specimens examined was 50, of these

36	were from men ;	of these there were diseased	22
14	"	women ;	" " " "
			7
	Total,	.	29

The morbid changes affect

the naso-pharyngeal region alone,	.	13 times.
the auditory organs alone,	.	8 "
" " " and naso-pharyngeal region,	8	"
		—
Total,	.	29

The respective ages were

between 10 and 20,	.	.	.	.	1
" 20 " 30,	.	.	.	.	10
" 30 " 40,	.	.	.	.	5
" 40 " 50,	.	.	.	.	12
" 50 " 60,	.	.	.	.	0
" 60 " 70,	.	.	.	.	1
					—
Total,	.	.	.	.	29

Sex	Age	KIND OF AFFECTION	KIND OF PHTHISIS	Complications in the	
				Larynx	Intes- tines
		<i>Affections of the naso-pharyngeal region alone.</i>			
1	41	Ulceration of the tonsilla pharyngeale.	Peribronchit. dissem., vomica lob. super. destr.	1	1
1	50	Ulcerations of the roof of the pharynx extending to the orifice of the Eustachian tubes; erosions on the mucous membrane of the orifice.	Peribronchit. dissem., vomica inveterat. lob. super. utr.	1	1
1	32	Bowl-shaped ulcer of the roof of the pharynx extending over the mucous membrane of the posterior wall of the pharynx.	Peribronchit. et bronchopneum. dissem. caseos.; vomica lob. super. d.; pleurit. adhaes. dextr.	1	1
1	30	Ulceration of the orifice of the left Eustachian tube, covered with nodules.	Pneum. desquam., vom. lob. sup. utr.	1	1
1	26	Ulceration of the mouths of the tubes; the mucous membrane of the roof of the pharynx appears honey-combed.	Peribronchit. dissem. caseos. bilat.	1	1
1	26	Ulcer of the pharyngeal tonsil.	Peribronchit. dissem., caverns especially in the left upper lobe.	1	1
1	25	Ulcerations of the naso-pharyngeal region, including the posterior wall of the pharynx and the mouths of the tubes.	Peribronchit. dissem.	1	1
1	25	Grater-shaped ulcer of the pharynx lined with nodules.	Peribronchit. tuberc. pleuro-obliterat. and caverns r.	1	1
1	46	Two deep, bowl-shaped ulcers of the roof of the pharynx.	Empyema sin.; peribronchit. caseos. bilateral.	1	1
1	27	Two ulcerations of the roof of the pharynx, one of which, situated near the tonsil, exposes the bone.	Peribronchit. dissem., vomica lob. super. utr.	1	1
1	31	Colloid cyst in Rosenmüller's fossa (right).	Peribronchit.; cavities.	1	1
1	23	Cyst, of the size of a bean, at the roof of the pharynx.	Peribronchit.; cavities, especially in r. upper lobe.	1	1
1	43	Retention-cyst, near the tonsil, about half the size of a cherry-stone.	Peribronchit. dissem. caseos.; caverns in r. upper lobe.	1	1
		<i>Affections of the auditory organs alone.</i>			
1	33	Otitis media sicca bilateral.	Bronchopneum. caseos. bilat.; caverns in r. upper lobe	1	1
1	49	Otitis media sicca bilateral.	Peribronchit. dissem. acut.	1	1
1	29	Otitis med. suppur. dextr. ear. creser. pariet. labyrinth (cyst in antrum of Hlghmore of r. side)	Bronchopneum. caseos. d.; peribronchit. apic. sin.; bronchiectasiae.	1	1
1	68	Otitis med. exsudat. mucosa sin. sine perfor. mbr. tymp.	Peribronchit. dissem. tuberc. ex epididymit. caseos.	1	1
1	28	Otitis med. exsudat. mucosa sin. sine perfor. mbr. tymp.	Cirrhos. et peribronchit. bilateral.	1	1
1	26	Otitis med. suppur. dextr., defect. mbr. tymp.; caries pariet. tympan.	Cavities on both sides.	1	1
1	47	Otitis med. dextr. suppurat. sine perforat. mbr. tymp.	Empyema sin., peribronchit. caseos.; caverns.	1	1
1	47	Otitis med. mucosa sin. sine perforat. mbr. tymp.	Peribronchit. et bronchopneumon. caseosa; caverns on left side.	1	1

Sex	Age	KIND OF AFFECTION	KIND OF PHTHISIS	Complications in the	
				Larynx	Intestines
		<i>Affections of the naso-pharyngeal region and auditory organs.</i>			
1	44	Otitis med. sicca sin., suppurated cyst near the tonsilla phar.	Cirrhos. et peribron. dissem., pleurit. adhesiva fibrosa. Pneumothor. dextr., bronchopneumon. caseos. et vomica pulm. dextr. Cirrhos. lob. super. utr.; caverns in r. upper lobe, peribronchit. dissem. caseos. Cavities in the apices of both lungs; peribronchit. dissem. Slaty induration and peribronchit. dissem. and bronchopneumon. caseosa in both lungs. Tuberculos. pleura; cavities in both lungs.	intact	intact
1	40	Otitis med. mucosa bilateral sine perforat. mbr. tymp. cicatricial cords in the roof of the pharynx.			1
1	42	Otitis med. suppur. dextr. c. perfor. mbr. tymp. et caries pariet labyrinth; hemorrhages in the mucous membrane of the roof of the pharynx.			1
1	19	Otitis med. mucosa sin. sine perfor. mbr. tymp.; cicatricial cords in the mucous membrane of the roof of the pharynx.		1	1
1	25	Otitis med. sicca bilateral sine perfor. mbr. tymp.; small cyst, the size of a hempseed, in the mucous membrane of both of Rosenmiller's fossae.		intact	intact
1	41	Otitis med. mucosa bilateral. c. perfor. mbr. tymp. dextr. sine perfor. sin.; large ulcer of the roof of the pharynx, extending on both sides as far as the mouth of the tube	Cirrhos. et bronchopneumon. caseos. sin.; peribronchit. et tuberculos. pulm. dextr. Pleurit. tuberculos. bilateral., peribronchit. dissem.		1
1	28	Otitis med. mucosa dextr. sine perfor. mbr. tymp.; crater-shaped ulcer near the pharyngeal tonsil, surrounded by cicatricial bands and small cysts.		1	
1	33	Otitis med. sicca sin., membr. tymp. non perfor.; ecchymos. multiplic. mucosae tegminis pharyngis.		1	1

## ON THE BAD EFFECTS OF ALUM GARGLES UPON THE TEETH.

LETTER FROM H. B. YOUNG, M.D.

DR. H. KNAPP, NEW YORK CITY.

DEAR SIR :—Recollecting you expressed in one of your clinical lectures while I was with you at the "Institute" some weeks since, a desire for information in regard to the bad effects of alum gargles upon the teeth, I contribute my mite, hoping that it may not be judged unworthy of consideration.

I will recount my experience in one case as briefly and succinctly as possible, regretting that my experience is limited to this one case and my investigations are not more thorough.

With kind regards, etc.,

H. B. YOUNG, M.D.

BURLINGTON, IOWA, *March 14, 1881.*

A young married lady living twenty-five miles out of town, suffering with chronic catarrhal otitis media, combined with pharyngitis, at my suggestion began the use of a weak alum gargle, which proved so grateful to her throat that she continued to use it freely for some two or three weeks. At the end of this period she was astonished one morning, while eating, at the sudden crumbling of a tooth.

As I had previously told her of the recent suspicions concerning the action of this almost domestic remedy, she reported herself at once to her dentist (Dr. W. P. Smith, of Monmouth, Ill., a man of more than ordinary skill and intelligence), and was assured by him that the gargle most likely had had, and if continued without the use of a counter-agent undoubtedly would have a prominent part to play for her in the way of tooth-crumbling.

She thereupon reported to me what she had learned, and to satisfy myself that there was no mistake about it, I at once addressed a note to the doctor, asking the "whys and wherefores."



I will quote from his reply :

"Alum is not a sufficiently powerful acid to do much injury in a mouth where the enamel is of good texture, heavy and *perfectly closed*. But where 'tis thin and there are *fissures* allowing it to reach the dentine, it will do the best it can to destroy the integrity of the latter. The organization of your patient's teeth is in this respect faulty. Still, if she would immediately rinse the mouth with a solution of sodium bicarbonate, she might continue the gargle with comparative safety."

Acting upon this suggestion I prescribed the soda wash. But this proving to be nauseous to the patient, both the wash and the gargle were shortly discontinued.

Taking the above explanation as correct it would seem that the action is not, as was supposed, *primary* upon the enamel (converting it into a chalky product), but *secondary*, causing degeneration by defective nutrition,—the ordinary process of decay. To my mind it is a very rational explanation; and one much easier of comprehension than that the resistance of the enamel to external agents is in inverse ratio to its density and hardness,—the sum and substance of the direct chemical action theory.

It may, nevertheless, be incorrect, for one case and one opinion, unfortunately, do not make conclusive proof; and alum may be proven to have a particular affinity for enamel. But correct or incorrect it has one great merit. It naturally suggests a safe plan of action, namely: when it is proposed to use an alum gargle, first examine into the condition of the teeth, and if the enamel be *thin* and *fissured* to insist upon the subsequent and immediate use of a counter-agent.

## APPLICATION OF COTTON PELLETS IN DESTRUCTION OF THE MEMBRANA TYMPANI ; TWO CASES.

BY A. S. CORE, M.D., QUINCY, ILL.

I NEED not offer any special apology for communicating some observations on the application of cotton pellets as hearing discs. I wish to call attention to the method of preparing them with vaseline as Dr. Cl. J. Blake has suggested. After the disease has become stationary I use the vaseline instead of glycerine, press the cotton-wool into wafer shape, and introduce it as lately described by Dr. Knapp. I find that vaseline does not cause the watery discharge from the ear, which the 25-per-cent. solution of glycerine causes in my cases. The vaseline being more tenacious the discs are more easily adjusted by the patient, and can be worn longer, as they do not lose their moisture so readily.

CASE I.—Miss I., aged 24, came for treatment, complaining of a discharge from both ears, which had existed since her first year and could not be stopped. She had been informed that if the discharge were stopped death would be the result. The patient's general health was good, her hearing  $h \frac{1}{2}$ ,  $v \frac{1}{6}$  in each ear, bone-conduction good. On examination I found that the *Mtt.* were totally destroyed, the ossicles displaced, adhesions drawing the point of the handle of the malleus inward and backward ; this condition existing in both ears, with a very fetid purulent discharge ; granular pharyngitis, tubes constricted. I controlled the discharge with a solution of pot. permanganate, and opened the Eustachian tubes with the catheter. I applied first the Toynbee discs, and found that they increased the hearing to about  $v \frac{1}{6}$ , but they were difficult for the patient to adjust and would not remain in position. Cotton pellets moistened with vaseline caused no unpleasant feeling, were easily adjusted by the patient, and increased  $v$  to  $\frac{2}{6}$  in each ear. The cotton pel-

lets saturated with glycerine always caused a profuse watery discharge which would last until the glycerine was all absorbed. At times there was vertigo, which I could attribute only to the production and retention of the discharge.

CASE 2.—Mr. C. Mc., aged 28, consulted me, stating that he had had otorrhœa from his infancy. I found large perforations in both *Mtt.*, handles greatly drawn out of place, mucous membrane very much swollen and thickened, and a thin greenish muco-purulent discharge, *h*  $\frac{1}{\infty}$ , *v*  $\frac{1}{6} \frac{2}{0}$  in both ears. Bone-conduction good. I syringed the ears with a weak solution of sodium biborate, applied cotton pellets moistened with glycerine, which caused a very profuse secretion, and for a short time raised his *v* to  $\frac{1}{6} \frac{0}{0}$  in each ear. He returned three days later, his hearing as at first, the cotton pellets saturated with laudable pus. I continued the syringing and employed dry plugs of absorbent cotton. Six days later the discharge had nearly stopped, but the mucous membrane was red and swollen. I instructed him in introducing the cotton pellets moistened with vaseline, which increased his hearing to *v*  $\frac{1}{6} \frac{5}{0}$  on each side. Patient returned to his home. He has continued the use of the cotton pellets and the discharge has stopped. He removes the discs once a week, syringes the ears with a weak solution of sodium biborate, and has no cause for complaint, his hearing remaining *v*  $\frac{1}{6} \frac{5}{0}$ .

My experience is that the pellets should not be worn at all when the discharge is abundant and offensive. When it is partly stopped, the pellets saturated with a solution of glycerine will answer best, as they surely have a good effect on the mucous membrane; but as soon as the discharge becomes scant or disappears altogether, I think that the vaseline should be used, as it has no bad effect on the mucous membrane. The vaseline pellets might be worn indefinitely, but as they are apt to become unclean in a week or two, they ought to be changed once a week after the ear has been cleansed. While my patients are under treatment I teach them how to cleanse the ears, and how to remove and replace the pellets. There is almost always a lack of cerumen in such cases, which the vaseline corrects to some extent. A bent, long, delicate wire "hair-pin" answers a very good purpose for removing and replacing the discs where patients are unable to buy the angular forceps.

## BILATERAL RUDIMENTARY AURICLE WITH ABSENCE OF THE EXTERNAL AU- DITORY CANAL.

By H. KNAPP.

**R**UDIMENTARY development with bony closure of the external meatus on one side is not uncommon, but we very seldom find this condition on both. In my own practice I have seen only one such case. This case, apart from its rarity, presented several features of interest to warrant me in communicating its clinical history.

Mr. John K., æt. 30, of Washington, D. C., of healthy parentage—no consanguineous marriage—was born with a rudimentary auricle on both sides. The auricle presents a curved, crook-like ridge of skin, which in the upper curved half contains cartilage, whereas the lower half, which has the feel of the lobule, consists only of skin. Behind the rudimentary auricle there is a flat, round depression of half an inch in diameter, bordered posteriorly by a well-developed mastoid process. Placing the finger in the depression, the movements of the lower jaw are felt as distinctly and in the same manner as when the finger is placed in a healthy auditory canal. The depression behind the ear, therefore, corresponds to the external meatus. Dr. S. W. Gross, of Philadelphia, 13 years ago, unsuccessfully attempted to open the passages. A scar, running along the anterior margin of the rudimentary auricle, indicates the incisions made by the surgeon.

The whole head, and, in particular, the pharynx, nose, and jaws are well developed. A catheter can be introduced into the tubes, and the stream of air is well heard to penetrate into the tympanic cavities, when a stethoscope is applied both in front and behind the rudiment of the auricle.

He hears the watch ( $\frac{3}{4}$ ) from all parts of the skull, but not from the teeth. Turning one ear toward the speaker,  $v = \frac{1}{6}\frac{2}{0}$  on either side. Turning the face toward the speaker and closing his eyes,  $v = \frac{3}{6}\frac{5}{0}$ ; it makes no material difference whether in so doing he holds nose and mouth shut or open. The audiphone does not increase his hearing. He understands loud voice with some difficulty at the distance of five or six feet, and is able to carry on a conversation, though a little laboriously. His speech has nothing strange either in loudness, pitch, or timbre. He hears all musical sounds from the lowest tone of a piano to a König's rod of 12,000 vibrations in the minute.

Apart from his ears, he is a well-developed, healthy, and strong man, of average intellect and education. He has learned the trade of a currier, and is a good workman. He consulted me not so much to have his hearing improved as to tell him where he could obtain artificial ears to mask his deformity.

# ON THE HISTOLOGICAL CHANGES IN THE BONY AND SOFT PARTS OF THE MIDDLE AND INNER EAR, IN CARIES OF THE TEMPORAL BONE.

BY S. MOOS AND H. STEINBRÜGGE, OF HEIDELBERG.

Translated by WILLIAM C. AYRES, M.D.

(With table iii, figs. 1-4, and a chart of the temperature on table iv.)

*Chronic otorrhœa of 18 years' standing in the left ear. Loss of memb. tym. Multiple polypi. Paralysis of the n. facialis. Total deafness of left ear. Vertigo during the last 3 days of life. Death by abscess in the cerebellum. Caries in many parts of the pyramid, with extensive changes in the labyrinth. Hyperostosis of the mastoid process, and roof of the drum cavity.*

Franz Waschadka, 23 years of age, a miller from Bohemia, came to the clinic June 22, 1880, seeking an operation on account of the formation of polypi in his left ear. In his family, both parents are living. The father healthy, but the mother suffers from a disease of the lungs. The patient had scarlet fever when 5 years old, and since that time has suffered from a purulent inflammation of his left ear. When 13 years old he consulted a physician who found polypi, which diagnosis was confirmed by his army surgeon. He did not conclude to have an operation performed until lately. With the exception of his ear trouble his health has been good.

On examination it was found that the canal on the left side was widened, so that a speculum, the smaller end of which was 7 mm. in diameter, could be introduced with ease. The canal was completely filled by several polypi. Hearing entirely



lost, the tuning-forks  $a'$   $c'$  and  $c$  being only appreciated by the right ear. When placed on the forehead, no subjective noises nor vertigo.

On the following day some of the polypi were removed with Wilde's snare, and the largest tumor with polypus forceps. It was flattened, and measured 24 *mm.* in length, 12 *mm.* in breadth and 7 *mm.* in thickness; there were irregular nodular protruberences from its surface which were again covered by cysts, the whole presenting the appearance of a strawberry excrescence. A second polypus had a rounder form 7 *mm.* in diameter, showing the beginning of nodular formations. Besides these, several round and oval pieces were removed which corresponded to the largest tumor in their structure. After the operation bleeding was copious. On the 24th and 25th the remains of the polypi were cauterized by galvano-cautery, and later the ear simply cleansed. On the 29th of the same month a solution of acetate of lead (4.0—40.0) was applied and continued only to July 2d. On using the sound, parts of swollen mucous membrane were felt, and also in the vicinity of the wall of the labyrinth, the bone had been laid bare. No tumor-remains could be discovered. Since the patient wished to return to his work, feeling healthy in everything except his ear, he was given alum to use, and instructed to return from time to time to the clinic. Returned July 17th, where there was no change in the condition of his ear. Secretion slight. He wrote on August 3d that he had been suffering for a few days with a severe pain, sometimes in the left ear and in the temple, sometimes in the left half of the occiput, that he could not close the left eye, and that the mouth was drawn over to the right side. The discharge from the ear remained the same.

On August 5th he presented himself to Moos who diagnosticated paralysis of the left facial nerve; in the canal were no relapses of polypi, but on account of his critical condition he was advised August 9th to go into the hospital and be treated by Prof. Friedrich.

In the history in the books of the hospitals<sup>1</sup> we find "patient looks much reduced—badly nourished, deep grooves in his neck. Cheeks red and feverish. The whole left side of his face immovable, the left corner of the mouth hanging a little; the left eye cannot be closed; the uvula hangs vertically. Pupil moderately dilated. Organs of the chest normal. Disturbances in

<sup>1</sup> For the completion of our notes of the case we are indebted to Dr. Thost, Assistant of Prof. Friedrich.

his stomach; tongue thickly coated; constipated; urine contains many phosphates; no albumen; its sp. grav. 1019. Temperature  $38.1^{\circ}$ . Pulse 80. At the bottom of the auditory canal is a mass of granulation tissue the size of a pea. Ordered ice bags to his head. Aq. laxativa Vienn. Ear washed with solution of salicylic acid." In the following few days the temperature varied between  $38^{\circ}$  and  $38.8^{\circ}$  (see curve, table iv.) with a pulse of 80-92, but on August 12th it rose to  $39.1^{\circ}$ , and on August 14th sank again to  $37.0$ , with pulse at 108. His subjective condition was somewhat better; his pain had left him. As the pus had a free outlet, and we did not wish to subject the patient to the excitement of a second operation, we did not remove the small, new formation from his ear. On August 16th functional examination gave the same results as before, viz., absolute deafness on the left side. Tuning-fork on the forehead only heard by right ear. The left mastoid region was not swollen, nor sensation on pressure.

*Aug. 18th.* Headache more severe, and patient complained of vertigo on sitting up. Notwithstanding the temperature was not above  $37.2^{\circ}$ , the pulse was as low as 48 to the minute. He had the appearance of one afflicted with typhus, was apathetic, his expression dull and his speech slow. Tongue thickly coated, with red edges; odor fœtidus; loss of appetite; slight nausea; passage only after aq. laxativa.

*Aug. 19th.* Temperature  $36.7$ , pulse 48. Severe headache and strong vertigo. Pupils dilated.

*Aug. 20th.* Slight ptosis of right upper lid, pupils dilated. Sight and motion of eye normal. Retained his consciousness. No signs of paralysis of the extremities nor of the sphincters. Temperature  $36.5^{\circ}$ , pulse slow, and intermittent. Specific grav. of urine 1017, depositing a copious sediment of phosphates.

On the morning of August 21st deep coma, while during the previous night his condition had not changed. The pupils were now narrow, and the cornea insensible; drooping of the lower jaw; death at 8.15 in the morning.

At the *post-mortem* the spinal cord and also the hemispheres of the cerebrum, even the coverings, were found to be normal. On opening the tentorium cerebelli, the thin walls of an abscess in the cerebellum were broken, when a quantity of thin, green pus escaped. The abscess comprised the greater part of the left hemisphere and a small portion of the vermiform process. The substance of the brain immediately surrounding it was studded with

hemorrhagic points. Pia and arachnoidea of the same side were opaque, while the dura-mater on the posterior surface of the temporal bone was thickened and discolored, showing a small round perforation in the region of the aperture of the aquaduct vestibuli. The acoustic and facial nerves of both sides at their origin had the same microscopic appearance.

The pus from the abscess was examined immediately after the opening, and found to contain large quantities of bacteria which however is of not much importance, since we were not able to find them in the temporal bone after having been preserved in Müller's fluid. Nevertheless we mention this condition on account of the late publications of McBride and Bruce<sup>1</sup>, and also on account of the recent interest in bacteria aroused by the investigations of Nägeli, Buchner, Pasteur, etc., and others.

As to the other organs, there was found an intense catarrh of the stomach, redness and swelling of its mucous membrane, enlargement of the intestinal follicles, and intumescence of the mesenteric glands. The nerves were very hyperæmic. Lungs normal even to the apices.

#### *Condition of the Left Temporal Bone.*

An examination of the walls of the sinuses showed them to be normal, notwithstanding that the bony ridge of the sub-petrosal sinus showed a carious defect in the middle of its course. On the posterior wall of the pyramid in the region of the aperture of the aqueductus vestibuli, a deep defect in the bone was visible. At this place the perforation of the dura mater had taken place. Shallower defects in the bone extended from this locality medially toward the lateral wall of the porus acusticus internus. The fibrous covering was thickened over the superior angle of the pyramid medially from the eminentia arcuata, on the roof of the vestibule to the hiatus canalis fallop. The hiatus itself was widened, the ganglion geniculum thickened, and the major superficial petrosal nerve maj. appeared as a thick string isolated from the ganglion. The anterior wall of the fallopian canal was for the most part destroyed from the hiatus to the anterior edge of the oval window, and at this place the facial nerve lay free and also showed a

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<sup>1</sup> *Journal of Anatomy and Physiology*, vol. xiv, part 2.

thickening of its diameter. After chiseling open the transverse portion of the fallopian canal, centrally from the hiatus, the facial nerve appeared as a thin, gray, gelatinous string, which broke during the examination. Toward the porus acusticus it was again more consistent, and macroscopically assumed a more normal aspect.

The microscopic examination showed that the increase in size of the large petrosal nerve, was caused by a thickening of its connective-tissue sheath. In the centre were only a few nerve fibres, surrounded by a thick sheath of fibrous connective tissue, appearing as if they were protected from total destruction by the formation of new tissue around them. A more exact description of the condition of the fibres of the facial nerve centrally from the bend, will be given when we examine the labyrinth.

The roof of the drum cavity consisted of hard, thick, sclerosed bony tissue very difficult to cut, which when removed exposed a softer tumor mass that completely filled the upper part of the drum cavity, and also the mastoid antrum. It was at first considered a polypoid formation, but afterward by microscopic examination showed itself to be the mucous membrane of these cavities which was enormously thickened. Microscopic sections through the mass removed unbroken from the bone, showed that it was hollow, the sections presenting semi-circles, one end of which corresponded to the free surface of the mucous membrane, the other to its former attachment to the bone. On the outer periphery of these semi-circles of periosteal tissue, larger blood-vessels were found, while on the inner were small capillary loops, corresponding to papillæ, the interspaces of which were filled in by large cells, corresponding to the rete malpighi of the skin. In well preserved preparations, the papillæ were covered by several layers of these cells which gradually passed over into a kind of epidermis, showing a transformation of the mucous membrane of the drum cavity into epidermis, as has already been described in connection with long standing otorrhœa. The stroma of this mass was rich in blood-vessels, and densely infiltrated with small round cells. In the deeper parts corresponding

to the periosteum, on account of the larger size of the fibres, these cells were fewer in number and were flatter or more spindle shaped. If we examine these papillæ detached from their surrounding tissues they seem as if they could represent formations which could be easily transformed into polypi by an increase in growth; and indeed microscopic examination of the polyps which were removed showed a great similarity to the hypertrophied mucous membrane, with the exception that they were covered by a cylindrical epithelium.

The ossicles were destroyed with the exception of a small remnant of the head of the malleus, which was imbedded in a thick mass of mucous membrane. The tendon of the tensor tympani muscle was adhesive to the same mass, and the body of the muscle was abnormally thick. The microscope showed thickened fibre sheaths of the muscle fibres, and the fibres themselves had undergone morbid changes. While in some parts the striation of the fibres was plainly to be seen, in other localities only longitudinal striæ were visible. In a later stage of degeneration the fibres appeared swollen, thickened, and filled either with a finely granular, molecular, or a homogeneous waxy mass. Some of them showed a beaded appearance instead of the straight contour, or even a twisted condition (see fig. 2, tab. iii).

Finally the contents of the fibres were absorbed (evidently the last stage of the process), when in many places we could see only an empty tube representing the sarcolemma, whose diameter was often a minimum. The whole condition is similar to the process described by Friedrich in his work on progressive muscular atrophy with this difference, that a proliferation of the nuclei of the fibres could not be demonstrated. As Friederich considers progressive muscular atrophy as an active inflammatory process, and compares the result of the same to the degeneration of the muscle fibres in the vicinity of diseased joints, fistula and tumors, we shall not be greatly in error if we consider the degeneration of the fibres of the tensor tympani muscle resulting from chronic inflammations of the middle ear, as belonging to



this class; that is, that they take on this degeneration in consequence of the diseased condition of the neighboring parts.<sup>1</sup>

On sawing through the mastoid process, it was found to be totally sclerosed, and also hypertrophied, extending upward, so as to have pushed the bony ring of the sigmoid sinus backward. The distance of the mastoid antrum from the outer surface, measured in the direction of the external canal, was 2.7 *cm.*, and from the middle of the bony part of the canal in a horizontal direction backward, 2 *cm.*

The left pyramid was left in osmic acid, one per cent., for three days, and afterward decalcified according to the method given in these ARCHIVES. It was then divided into two parts by a section perpendicular to its longest axis. On separating the two halves, on the lateral piece, we could distinguish two small carious openings, separated by a bony partition only 1 *mm.* wide. These stood in direct communication with the caries in the canal for the facial nerve. On the medial half was a hole several millimetres wide, filled with spongy tissue, extending below the porus acusticus internus and the cochlea. It extended laterally almost to the point of the pyramid. This carious defect opened into the fossa jugularis, whose periosteum was thickened, probably preventing the vein from being destroyed.

The opening in the medial piece corresponded to a similar one on the lateral, both being filled by the same substance.

Three or four millimetres deeper was another passage made by the caries, extending from the lateral wall of the porus acustic. int. to a cavity 1 *mm.* in diameter in the bone substance between the semicircular canals.

After removing the hypertrophied mucous membrane from the labyrinth, we found the inferior and anterior wall of the oval window destroyed by caries, but the walls of the vestibule were not changed.

There was also a round carious opening of 1 *mm.* in diameter on the promontory corresponding to the first convolution of the cochlea.

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<sup>1</sup> We also found similar degenerations in the musc. stapedius.



With the enumeration of these numerous carious defects, seen macroscopically, the description is by no means complete, as will appear by the following :

*Microscopic condition of the labyrinth.*

First of all, there is a marked difference between the condition of bone of the pyramid and at the vicinity of the vestibule and semicircular canals, of the modiolus and of the capsule of the cochlea.

It was hard in cutting, and showed only isolated carious defects under the microscope, while in the modiolus and cochlea capsule these were numerous, and, indeed, were even the rule. The former was hollowed out at the sinuous base, and filled up by a mass which will be later discussed.

In the cochlea capsule there was a system of carious spaces (in section), arranged in a circular order around the cochlea canals, sometimes small, often large, round, oval, or irregular, frequently extending as far as the periosteum of the internal cavity. This was penetrated at one place near the capsule. A more exact microscopic analysis of the section furnished us the beginning of the pathological process in the bone, and also the character of the mass which filled up the carious spaces. In those sections where the periosteum was still preserved, there was always a more or less extensive infiltration of pus corpuscles between it and the edge of the bone. From here the purulent infiltration passed into the interior of the bone through the Haversian canals, covering the outer walls of the vessels. In this locality were also larger or smaller tracts where the cochlea capsule was morphologically changed, which evidently could only have been brought about by disturbance of nutrition of the bony tissue, that is, from a qualitative chemical change in the nourishing fluids in the part.<sup>1</sup>

We could see well-preserved cartilaginous capsules arranged in different groups in an abnormally transparent ground substance (see fig. 1, tab. iii), and we are justified in considering these appearances in the central portions of

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<sup>1</sup> We must remember that ossifications in the cochlea capsule are somewhat analogous to the general type of metoplastic ossifications. We also find numerous islands of curilage in the normal cochlea capsule of adults.

the bone as the beginning of processes which will later result in carious holes and protuberances.

If the disturbance of nutrition goes further, the cartilaginous parts will degenerate in their capsules. In the beginning their contents will be cellular, afterward granular, and finally there will result complete necrotic degeneration of the capsule into a molecular mass, which will fill up the holes, etc., when the carious process is completed.

In other parts of the labyrinth which show apparently the usual bony structure, we found in the cavities which were produced by caries, such remnants of cartilaginous tissue, bearing evidence that in the formation of the tissue of the temporal bone, a large part of the cartilage cells persist, and are directly calcified.

As already remarked, the periosteum of the porus acusticus internus was thickened. Nevertheless, the blood-vessels were filled with blood without showing any anomaly in their shape or texture. The same was also found in the blood-vessels of the facial and acoustic nerves.

The facial showed a granular degeneration of its fibres in its transverse course through the temporal bone, while centrally from this place of softening only a very slight degeneration had taken place. The greater portion of it was enlarged by a swelling of the medullary substance, was bent and twisted, but retained the double contour (see fig. 3, tab. iii).

In the acoustic nerve the histological changes were much more manifest than in the facial. It was atrophied from beginning to end; coagulation of the myeline in the shape of cubes or concentric rings; granular degeneration or total disappearance of the medullary substance was seen, combined with a striking hyperplasia of connective tissue (see fig. 4, tab. iii).

The mass which filled up the carious defects in the modiolus was composed of vascular connective tissue; the vessels were similar to those in the periosteum of the porus acusticus internus. Besides this there were larger and smaller nests of pus corpuscles with fragments of nerve fibres.

The contents of the cavity of the lamina spiralis ossea was very much changed. In some places it contained fibres which were in connection with the nerve fibres of the modiolus, and in others these were wanting. Most of these were destroyed, and the space filled with a molecular detritus, or was empty (perhaps in the latter case, the detritus masses had fallen out in preparation).

The whole lamina spiralis membranacea was wanting from its insertion to the spiral ligaments, leaving only a detritious mass, which colored brownish-yellow with osmic acid, in which were portions of the zona pectinata.

The cavity of the vestibule seemed to be filled by the same mass; the sacculi were destroyed; there were also some fragments of the stapedius muscle (evidently brought there by preparation), pus corpuscles, fat globules, and nuclei, which colored black by osmic acid, all surrounded by a common membrane. The same condition obtained in the connective tissue portions of the superior and posterior semicircular canals, and their ampullæ, and also in a small part of the horizontal canal, which was still preserved. The nuclei of the cells of the epithelium were wanting in many places, in others they were filled up with dark granules. The region of the crista of one of the ampullæ was infiltrated with dark granules, and also with small and large fat globules, colored by the osmic acid. These were probably the remains of the degenerated nerve substance, since the fibres in the vicinity had lost their double contours, showing here and there a very small axis-cylinder.

*Remarks.*—Since this case is remarkable for several reasons, we have thought it advisable to return again to its principal points of interest. Above all, it seems astonishing that the patient should have retained his capacity for work for so long a time, notwithstanding the extensive degeneration in the region of the pyramid, which had probably existed for a long time, and only became pronounced in its effects of late.

The different products of degeneration, brought about by a chronic inflammation, indicate an extended caries; and these products, again, seem to have furnished a cer-

tain protection against the rapid destruction of important parts, thereby saving the patient's life (provided his other organs were normal). For instance, the thickening of the dura mater behind the temporal bone, also its prolongation into the porus acusticus internus arrested the progress of the disease toward the brain; also the hyperostosis of the roof of the drum cavity, and the hyperplasia of the venous walls, and also of the periosteum of the fossa jugularis,<sup>1</sup> protected the vein from injury and consequent death by hemorrhage.

Further, the thickening of the connective tissue surrounding the horizontal part of the facial nerve; and of the major superficial petrosal nerve, in the vicinity of its connection with the ganglion geniculi, and, lastly, the sclerosis of the mastoid process, can be reckoned as a protecting condition, since they all tended to retain the products of suppuration within the cavities where they were found.

It is also remarkable that the left half of the palate was not paralyzed in consequence of the total destruction of the facial in its transverse portion, or before the exit of the larger superficial petrosal nerve. The uvula was straight, so that the evidence of this case is directly opposed to the opinion of some that the motor innervation of the velum is derived from the facial nerve through the spheno-palatine ganglion, and by the posterior palatine nerves by way of the large superficial nerves of the temporal bone.<sup>2</sup>

In regard to the fatal result of the case; from the temperature we were able to suspect an encephalic process with great probability. Notwithstanding the fact that the patient was treated only during the last 12 days of life, by the condition of the temperature we could exclude meningitis, and also phlebitis of the cerebral sinuses. The disease began without chills, and only on the fourth day (in the evening) the temperature rose to 39° C., and showed no fever from the sixth day on (reckoned from his entrance into the hospital).<sup>3</sup>

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<sup>1</sup> Compare Moos. *Clinic for Ear Diseases*, p. 250, remarks concerning a preparation in Politzer's collection.

<sup>2</sup> Compare our remarks in vol. x, page 30, of these ARCHIVES.

<sup>3</sup> Perhaps this condition stands in some connection with the suppuration in the brain, which was established at this time.

We may, however, hesitate between the diagnosis of an abscess in the brain and basilar meningitis. The pulse remained slow up to the last day, when, as in the last-mentioned disease, it always increases in frequency toward the end; also the absence of loss of vision, of convulsions or paralysees of the extremities, and the rythmical respiration speak against basilar meningitis. On account of the pain in the left side of the back of the head, and the vertigo caused by sitting up in bed, we were lead to think of an encephalic process in the cerebellum.

As to the symptom of vertigo, it might be uncertain whether it was caused by the condition of the ampullæ and semicircular canals, or by the disturbances in the cerebellum.<sup>1</sup>

*Aside from the question of the correctness of the hypothesis of a centre of equilibrium in the ampullæ, we would insist that in this case there was a direct implication of the centre of equilibrium in the cerebellum, and for the following reasons:*

From physiological experiments it has been determined that marked disturbances of equilibrium occur on irritating the peripheric ends of the vestibular nerves by traumatic influences, chemical or galvanic excitations, etc. (Spamer) Lesions of the nerve trunk and division of it, caused no such disturbances. Schiff was unable to remark unsteadiness in gait produced by section of the acoustic nerve, and was therefore sceptical as to this function for the vestibular nerves. It is possible that in the case of man a sudden impulse or a certain degree of continued irritation of the nerve endings in the ampullæ, might bring about severe symptoms of Ménière's disease, but in an extensive distribution in the labyrinth, or a section of the connection with the centre of coördination in the brain, this could not be the case.

According to this view, many cases which seemed to oppose the idea of a sense of equilibrium, are explained. The general course of Ménière's disease is, that besides the deaf-

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<sup>1</sup> There was a complication of the oculo-motor nerves (paralysis of the major levator palpebræ, suppuration and dilation of the pupils), but the motions on the eyeballs themselves were not interfered with; therefore, the vertigo could not have come from a paralysis of the ocular muscles.



ness, vertigo and subjective noises, fainting and vomiting occur, and in the better cases the latter symptom may disappear, but complete deafness, or very bad hearing remains. Instead of assuming that only the acoustic portion of the eighth pair, or that the cochlea alone had suffered, and that the portion for equilibrium had returned to its normal condition, we can also imagine that *the above symptom can also disappear after a complete destruction of both parts of the nerve*. According to this it would have to be supposed that in one-sided lesions the normal organ of the other side would have to keep up the function of equilibrium, while in double-sided destruction, the sense of sight, touch, and muscular movement would, in time, supply its place.<sup>1</sup>

In a similar manner we could also explain those cases in which the conduction of the nerves of equilibrium had been done away with in such a manner as not to produce an excessive irritation, or suddenly, by a trauma or by an acute inflammatory process. In such cases this sense can be suddenly destroyed without the occurrence of symptoms of vertigo, fainting, etc. In the first category, we can place Moos' case of Pachymeningitis (these ARCHIVES, vol. ix, page 97), and also the present case; in the second we may mention the case of gunshot wound, from the same author, (these ARCHIVES, vol. ii, p. 119), and also the one of Bing, viz., acute rheumatic paralysis of the acoustic nerve with complete deafness, without vertigo, etc. (*Wiener Med. Wochenschr.*, 1880, No. 11.)

In applying this to our present case, we would again call attention to the fact that hearing was already lost in the left ear at the time the patient came under observation. According to the examinations, it was found that the caries was more pronounced in the cochlea than in the region of the semicircular canals; and further, we could conclude from the connective-tissue degeneration of the acoustic nerve in the internal-auditory meatus that the inflammatory process in it, must have been of longer standing. If we consider

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<sup>1</sup> Compare the case which Politzer described at the Congress in Milan: acquired double-sided destruction of the semicircular canals from bony obliteration, without any disturbance of equilibrium.



that the trunk of the nerve in the inner ear, and also that of vestibular nerves, were slowly destroyed by chronic inflammation, or had become paralyzed in the earlier stages of the disease, we can explain why it was that the disturbances in the region of the semicircular canals, which happened later, could not have been conducted from the periphery to the central organ.

If we distinguish the two conditions of irritation and paralysis of the acoustic portion of the eighth nerve, we easily see how subjective noises are sometimes present in diseases of the labyrinth, and sometimes not, and in the present case that they must necessarily have been absent. If we repeat again the foregoing, we believe that we are justified in stating that the series of conditions has been the following: *Caries of the cochlea; degeneration of the acoustic nerve in the vicinity of the inner ear; destruction of the parts in the vestibule; the semicircular canals and their ampullæ.*

If this be the case, we must attribute the vertigo, which set in only on the third day before death, to a probable extension of the encephalic process in the middle portion of the cerebellum to those parts which belong to the vermiform process, whether the centre of equilibrium itself was affected or the body of the nerves which lead to it.<sup>1</sup>

As to therapeutics, the pathological and anatomical conditions in this case are very important, viz., the extensive hyperostosis of the mastoid process, and the numerous macroscopic and microscopic carious spots in the pyramid. One of these conditions, viz., the hyperostosis, would have made the surgical opening of the mastoid process extremely difficult, even for the most skillful op-

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<sup>1</sup> Nothnagel remarks in his article on vertigo (Ziemssen's Handbook of Special Pathology and Therapeutics, supplementary vol. page 199). "We can consider that the sensation of vertigo can be brought about in a variety of conditions of the cerebellum, and transmitted to the centre of consciousness, the cerebrum. Experiment has shown that various kinds of distractions in these parts, including the greater part of the cerebellum, can take place and remain without effect." He further remarks: "only the destruction of the deeper nerve tracts show themselves to have effect, and the question still remains as to whether these deeper basilar layers of the cerebellum serve only as ways of transmission of fibres which pass to the real centre of coördination situated in some other locality."

erator,<sup>1</sup> and even if it were done in a perfect manner, the other conditions would have marred the clinical result, since we believe, and the readers probably also, that the extensive carious degenerations in the whole pyramid would have rendered the opening of the mastoid useless. On the contrary, such conditions of caries in the pyramid must warn us that in every case of long standing suppuration, in which other features lead us to consider an opening of the mastoid cells, we must be very careful, since, with our present facilities, we can not diagnose a carious condition of the pyramid of the temporal bone, as was in this case. If we open the mastoid in such a case as the present, the surgical interference will certainly hasten the death of the patient. Just the impossibility of diagnosing such a condition in long standing suppuration in the ear, even if the patient's constitution is the best, and he feels perfectly well, should make us very careful in framing a prognosis.

*Description of figures in table iii.*

Fig. 1.—A section of a part of the interior of the cochlea capsule just commencing to become caseous, Hartnack  $\frac{3}{8}$ . In the middle of the field of vision we find a large irregular mass with many spaces, which is partially surrounded by normal bony tissue. The space is filled with cartilaginous capsules sometimes isolated, sometimes grouped together. The ground substance is more transparent than normal. Left is a small part presenting the same characteristics, *kp*. Blood-vessel at *g*.

Fig. 2.—A teased preparation from the tensor tympanic muscle Hartnack  $\frac{3}{8}$  immersion. Right and left in the figure are normal muscle fibres, lying in the middle, and separated from these by connective tissue are pathological fibres. The change consists in a widening and an intestinal-like shape of the muscle tubes. The striation is somewhat indistinct, and, in places, entirely lost. In their stead we sometimes see a finely granular, opaque albuminous mass.

Fig. 3.—Three nerve fibres from a teased specimen of the fa-

<sup>1</sup> In regard to the frequent occurrence of hyperostosis of the mastoid process compare the article of J. O. Green : Osteo-sclerosis of the mastoid.—*Transactions of the American Otological Society*, vol. ii, part 4.

cial nerve. Hartnack  $\frac{3}{4}$  immersion. The double contour is still to be seen, the fibres themselves present a swelling of their medullary substance.

Fig. 4.—Is from a teased preparation of the cochlea nerve. Hartnack  $\frac{3}{4}$  immersion. We notice a number of nerve fibres which have lost their double contours. The fibres themselves are larger from a swelling of the medullary substance. This substance is undergoing a process of degeneration and coagulating in the shape of cubes or concentric rings. In some of the fibres (left below and right above) were obscure only nuclei which are placed in rows, and the fibres themselves very much reduced in size. Between the fibres is new-formed connective tissue.

In the chart of temperature, table iv, notice :

*M.* signifies 6 o'clock in the morning.

*Mi.* “ 12 “ in the day.

*Ab.* “ 6 “ in the evening.

Since the patient was apparently better on August 15th, the temperature was only taken once, and, on the next day, only in the morning and evening.

FURTHER OBSERVATIONS ON THE HISTOLOGICAL  
CHANGES IN THE LABYRINTH IN HEMOR-  
RHAGIC PACHYMEINGITIS (HÆMA-  
TOMA DURÆ MATRIS.)\*

BY S. MOOS AND H. STEINBRÜGGE, OF HEIDELBERG.

Translated by WILLIAM C. AYRES, M. D.

Susan Riednizer, born Feb. 12, 1810, widow, from Aglastershausen. Admitted to the insane asylum on Jan. 21, 1879. Died Feb 3, 1880. Heredity not substantiated. Two of her brothers and sisters died of dropsy ; a brother of tetanus, after having had convulsions. The patient had had twelve children : four died of convulsions, one five and a-half years old of croup.

The grandchildren were comparatively healthy. She menstruated at 16 years of age ; often irregularly ; sometimes ten to eleven weeks between. She does not remember when her periods ceased. Has had much trouble in life. She often had attacks of cramps and trembling when excited, but how long ago she does not remember. In later years she had varicose ulcers of the foot. Was married at 22, was very fat, worked hard, and was always better when she had work to perform. Never cared for company, and by industry and economy, she had had something to give to each one of her children. Was always somewhat irritable. When she had family troubles with her husband, with whom she generally lived happily, he would leave the room, returning only when she had again become rational ; was always a sparing house-keeper. After the birth of one of her children, at the age of 25, she suffered for several weeks from catalepsy ; she was cold and stiff, and had to be rubbed before she got over the attacks. Since

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\* Compare these ARCHIVES, vol. ix, part 2.

that time she had frequently jerkings in her hands. Her fingers were flexed, and the feet were likewise contracted. The attacks grew less, and have been very few and mild for about eight years ; only noticed when she was very much excited. From Nov., 1877, she was sick for a long time. She had to lay in bed for seven weeks, remaining with one of her sons ; since she did not agree with the stepfather of her other son. The reason was she often wished to mix herself up in the business, and made trouble with her step-daughter. The latter would then complain to her parents, and try to settle the differences quietly. The old woman was not satisfied, thought he wished to bring her and all of her children to the house of correction, etc. She was very restless, always getting into and out of bed, and always wishing to go away. At night she would frequently go to some other house ; was unsatisfied with everything and everybody. Before her sickness, and also during it, she complained very much of headache. She thought that the cramps had gone into her head, and made her crazy. For several months the eyes were stuck together in the morning. She threw things around, scratched the walls, and broke things generally. In the beginning of the month she took narcotics, would sleep nicely, but when she awoke would break things again. This continued the whole winter. As the weather grew warmer, she went into the fields to work, and seemed to feel better for it, but when the cold weather returned, and she had to remain in the house, she got worse. She was restless, thought she was persecuted, that her food was poisoned, and had her meals brought to her from the inn, and ate from her own utensils. She commenced to drink about one-eight litre schnapps, and one-fourth litre wine daily. After this the cramps went to her breast, but she thought she could always bring them away by drink, and felt better after. When she was restless, it could always be remarked that the left corner of her mouth jerked, and her tongue moved on the same side. Her head would get red, and she would look blue under the eyes. This happened frequently during her stay in Mosbach, in which place she remained for three weeks under observation, just before Christmas. When the condition of excitement was over (and they lasted only a short time) she would go off into some corner and hide herself ; would frequently lock herself up for days at a time. Her family did not like to have her about them. In Mosbach she would make a great noise at night, because she was persecuted ; was dissatisfied with every-

thing. Appetite good ; stools irregular ; constipation for two days, would be changed into diarrhœa. At present she sleeps well.

*Jan. 21st.*—Patient of medium statue, very lean, and looks as if she had worked hard all her life. The left side of the face is smaller, and the tongue a little projecting. Slight ptosis left ; left pupil dilated. Slight emphysema without catarrh.

*Jan. 23d.*—Headache.

*Jan. 28th.*—Complained of want of breath.

*Feb. 2d.*—Pain in her right hand ; fifth phalanx red.

*Feb. 5th.*—Incision ; copious evacuation of pus.

*March 3d.*—Numerous hallucinations, especially in hearing ; therefore did not wish to remain under treatment ; would rather go home.

*April 21st.*—Pronounced ptosis left. Right pupil wider than the left. Left pupil immovable. No difference in the facial with the exception that on the right slight clonic contractions, in the region between the end of the nostril and the corner of the mouth extending inward to the medial line. Left are no contractions. Sensibility normal. Great emaciation on the palm of the left hand, and it was more marked on the back of same hand than on the left (?). Says she often feels giddy, and does not know where she is.

*April 23d.*—Says she hears better on the left than on the right side.

*May 10th.*—Badly nourished.

*June 17th.*—Attempt at self-strangulation.

*Aug. 3d.*—Felon of the middle finger of the left hand. Incision. Phlegmon of the hand followed.

*Nov. 18th.*—Felon of the right ring finger.

Under a badly nourished condition, her restlessness and weak condition increased. Feb. 3, 1880, she became comatose, with cold cyanotic skin of the extremities, slow pulse, and died at 7 o'clock in the evening.

Clinical diagnosis : dementia senilis.

*Autopsy.*—A large quantity of fluid in the subdural space of the spinal cord. Pia somewhat opaque, thickened in places, and grown together with the dura. Substance of the cord somewhat discolored in section corresponding to the posterior columns.

Skull of medium thickness ; diploë abundant and congested. The sagittal sinus in its anterior segment ; an ex-



ostosis in the frontal bone the size of a pea. Deep depression on its inner surface.

Longitudinal sinus empty. Dura mater thick; a thick brown coat was found corresponding to the middle groove of the skull which could be separated from the bone and ran along the temporal bone; a similar formation at the left anterior groove, but not so thick. It also extended to the posterior groove.

The pia mater also shows a yellow discoloration on the left lobe.

The pia mater of both hemispheres of the cerebrum is thick, opaque, infiltrated with serum, and is easily detached. The convolutions are wide apart, with deep depressions between them.

In the lateral ventricles more serum; the ependyma somewhat opaque; substance of the brain, of the larger ganglia, and cerebellum, soft and moist, but otherwise not considerably changed.

We omit the appearances of the rest of the body and pay attention only to the anatomical diagnosis:

Pachymeningitis hæmorrhagica. Atrophy of the brain and all its parts. Marasmus senilis. Emphysema of both lungs. Catarrhal, pneumonia of the left side. General osteoporosis.

#### *Examination of the external and middle ear.*

*Right temporal bone.*—External canal normal. Drum-head pale and prominent in its posterior half, with the thinnest part of the protuberance above. Atrophied with the exception of a sinuous opacity at the periphery. No pus nor mucus in the drum cavity nor in the drum membrane. Promontory (in the region of the round window, which was normal) much changed: in its middle an almost round carious spot the size of a lintel, showing a small button-like protuberance from the bone (healed caries?).

The ostium tympanicum tubæ smooth, but considerably widened, which extended like a ridge over the promontory to the region of the stapes. The whole condition was evidently the result of a long-standing purulent inflammation of the drum cavity.

*Left temporal bone.*—External canal free. Drum-head has a tendonous thickening in its periphery, and atrophied in its posterior half. Promontory flat and pale. Tendon of the tensor tympani very thin. All other conditions normal, especially the stapes on both sides.

Unfortunately the history of the case is defective, and we were not able to find out when the ears had suffered, nor how long the process had lasted. It is, however, remarkable that she said she heard better with the left than with the right ear.

### *Examination of the labyrinth.*

*Method.*—The right temporal bone was first placed in Müller's fluid and after in alcohol, and only the porus acusticus int. its lining, and both nerves examined microscopically. The remainder was put in the pathological anatomical collection of the aural institute on account of the rare position of the caries.

The left temporal bone, after treatment with a 2-per-cent. solution of osmic acid, and decalcified according to the method given in vol. ix of these ARCHIVES, was histologically examined in all its parts.

### *The hemorrhages.*

While in the case already described by us, it was impossible to demonstrate hemorrhages macroscopically, as Manz and Fürstner have found between the sheaths of the optic nerve in pachymeningitis, in this one a similar condition was observed. The dura mater which covered the porus acusticus int. was normal, but in the immediate vicinity of the acoustic nerve there was a bright yellow discoloration 7 mm. in length and  $1\frac{1}{2}$  mm. broad. There was a similar condition along the lateral inferior wall of the transverse portion of the canalis facialis.<sup>1</sup> Microscopically they showed themselves to be caused by coagulated blood (fibrine with numerous red and white blood corpuscles) in a tissue similar to the arachnoidea; that is, a tissue composed of

<sup>1</sup> We found also a similar discoloration around the n. acusticus in the right porus auditor int.

fine fibres and columns covered by an epithelium of the usual form. (See Schwalbe, *Nervenlehre*, second edition. Structure of the brain, brain coverings, and cerebral nerves. Erlangen, 1880.) The extravasations covered the connective-tissue meshes, and filled up the spaces between them. We also found microscopic extravasations of blood between the bundles of the vestibular nerves near their exit,<sup>1</sup> and also more or less in the whole extent of the cochlear nerve up to its entrance into the modiolus. In the modiolus itself we could see them only in one preparation. Lastly, we found degenerated blood corpuscles between the primary nerve fibres.

*Result of the hemorrhages. Pigment.*

As to the method of absorption, we could only demonstrate the intercellular changes in the red blood corpuscles (Langhaus). In no preparation could we find evidence of an extra-cellular change, or even a participation of the lymph tracts in the absorption, as we saw in the cases already published.

*Location*—The pigment was either in the immediate vicinity of the blood-vessels or a little removed from them, also along the perineurium of the nerve bundles in the porus acust. int. or in the connective-tissue coverings of the parts of the vestibule and their adnexa, leaving the membrana propria and epithelium free. Altogether the quantity of pigment was small, both in the nerves and parts just mentioned; in the nerves it was only found between the individual fibres, while in the membranes of the vestibule only in the ampullæ and utriculus. None was found in the cochlea.

*The color* was black, yellowish-brown, or wine-color (red).

*The form*, amorphose accumulations of irregular quadrangular or round bodies and nuclei. The former were enclosed in a membrane, evidently cells containing blood corpuscles.

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<sup>1</sup> By diffusion of the blood these extravasations appeared paler than in other places.

*Condition of the blood-vessels.*

In the whole region of the labyrinth <sup>1</sup> the blood-vessels were all full of blood irrespective of their anatomical character. The blood corpuscles in their interior were cubical or polygonal, showing evidence of stagnation. Contrary to the condition found in our other case, the form and structure of the vessels were normal. There was a great prominence of the lymph vessels in the stem of the acoustic nerve, but we were not able to determine whether it was caused by some impediment to the lymph circulation during life, or by too strong an action of the osmic acid. In no place could we find evidences of an inflammation.

*Condition of the Nerves and the Membranous Labyrinth.*

The structure of the body of the nerves and their expansion in the cochlea were normal, also the soft parts of the vestibule and its adnexa, the soft parts of the cochlea, even the lamina basilar, membrane, and organ of Corti.

We could also remark that we found the phosphate of lime concretions of Böttcher, not only in their usual places in the porus, acusticus int., but also in the periosteum of the canali facial, in the aqueductus cochlea, and also in the jugular foramen (unfortunately we could not examine the aqued. vestib.).

*Remarks*—If we compare our present case with that published by us before, we find that they both show the same anatomical-pathological condition within the brain cavity. They are different in that in the first case the disease had lasted much longer and the attacks were more frequent (as shown by the autopsy, since the contents of the hæmatoma had degenerated to a serous fluid, and the sac had many layers), while in our *post-mortem* we found only a thick coating, which was evidently a recent product, and may have been produced by a single hemorrhage in the dura mater. From this macroscopic change in the skull cavity, we can also account for the microscopic condition of the labyrinth.

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<sup>1</sup> Also those of the normal mucous membrane of the promontory were filled with blood corpuscles in the same state.

In the first case we could see macroscopic hemorrhages nowhere in the labyrinth, while these were frequent in our case. Corresponding to the oft-repeated hemorrhages in the first case, we were able to find pigment degeneration of blood extravasation *in all parts of the labyrinth*, while in our case, since there was probably only one hemorrhage, we found slight and isolated pigment metamorphoses. We must call special attention to the extensive degenerations of the blood-vessels of the labyrinth in the first case. There were cell infiltrations of the walls, thickenings, dilatations, and even obliterations, while in the present case the vessels were normal.

If we hereafter corroborate this normal condition of the blood-vessels in cases of recent hemorrhage in the dura, we must conclude that the changes in the vessels described in the first case were secondary, and that the hemorrhages in the labyrinth depended upon a disturbance of circulation brought about by the disease within the skull cavity. On account of the mildness and duration of the disease in this case, an inflammation could not have been set up in the labyrinth severe enough to bring about atrophy and other degenerations, and consequently we find all of its parts normal.

It shows us also that those changes in the labyrinth which are caused by one single hemorrhage in the dura, can be restored to the normal (total absorption of pigment with no results of inflammation), and also functional disturbance disappear. For the practitioner, this is of particular interest, since it demonstrates that hæmatoma of the dura mater is curable (Griesinger, Hasse, and others).

As to the clinical symptoms, and especially the vertigo and hallucinations in hearing, even if we wish to consider that a patient can suffer so much from one single hemorrhage in the dura, we are by no means willing to concede that such slight disturbances as we have found in the labyrinth could bring about such symptoms.

The differences in hearing on the two sides must be explained by the conditions of the middle ear, but we were unable to obtain a history of the cause or course of the middle ear disease.

A PECULIAR CONDITION OF THE PAVEMENT  
EPITHELIUM OF THE ENDOLYMPHATIC  
CAVITIES IN MAN.

BY H. STEINBRÜGGE, OF HEIDELBERG.

Translated by WILLIAM C. AYRES, M.D.

(*With table iv, fig. 5.*)

THE membranous semicircular canal, the ampullæ, the utriculus, and sacculus, show a single layer of pavement epithelium with large round nuclei in those parts free from nerves. In the vicinity of the entrance of the nerve these cells are cuboid, and gradually change to cylindrical forms.

In our examination of the labyrinth, Moos and myself have found that in preparations treated with osmic acid, besides the homogeneous nuclei in the cells of this pavement epithelium, there are other formations composed of many small bodies with dark edges, which refract light strongly. They were either arranged in spherical groups, in irregular figures, or scattered about. Sometimes they were near the nucleus and encircled it, but frequently they were crowded into one corner of the cell polygon.

We were first inclined to consider them as an expression of some pathological process, and similar to fat-globules which are found in inflammations. However, in comparing them with the ears of persons who have never suffered from ear difficulties during life, we found that they were also present in normal ears.

The condition then became of some interest, when I found that the ductus cochlearis was also lined with pave-



ment cells containing similar little bodies. After making section through the cochlea, parallel to the long axis of the modiolus, I obtained a preparation which included a very small part of the third convolution, so that the epithelium could be seen from the surface, and the cells also showed the small bodies referred to.

Later they were found in other convolutions, and also on inner surface of Reissner's membrane, on the zona pectinata (see fig. 5, *a* and *b*), and ligament. spirale where it belonged to the ductus cochlearis,<sup>1</sup> neither exterior to the ductus cochlearis, nor within the scala tympani. They do not exist in the perilymphatic region.

We must, therefore, consider them as peculiar to the epithelium of the endolymphatic spaces, with the exception of the recessus labyrinthi whose epithelium is composed of small cells with large oval nuclei lying close together. In these they do not appear.

As to the form of the polygonal cells and their nuclei we can notice but little variety in the different parts of the endolymphatic spaces. In the cochlear we find only round nuclei with very regular circular contours, 0.005 *mm.* in diameter. The accumulation of the small bodies is about the same size as these nuclei as long as they are arranged in spheres. The nuclei show also a peculiar lustre, the same as we notice in the cells at the feet of the rods of Corti, and also in the nuclei of the external hair cells. In the semi-circular canals and utriculus we notice many bean-shaped nuclei (fig. 5, *c* and *d*) by the side of triangular ones. In the sacculus we find round nuclei 0.007–0.01 *mm.* in diameter. There may be individual differences in shape depending upon some condition of pressure.

With these facts the object of this communication has been reached, that is, if in the smallest degree it renders the examination of the normal and pathological labyrinth easier. We may, however, remark that these little bodies only occur in the endolymphatic region, and it may be im-

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<sup>1</sup> In profile, or where they belong to vertical sections, we can not demonstrate them, surface preparations of the membrana basilaris being preferable. The best are the first sections upon a convolution of the cochlear going from the vestibule. Strong osmic acid renders the examination easier.

aged that they may indicate some chemical change within the nucleus or cell body, furnishing some peculiarity of the endolymph, as in the epithelium of lymph glands. Even if the greatest part of the endolymph is produced by a transudation from the walls of the blood-vessels, or from the lymph spaces which accompany them (as we frequently see the small bodies resembling lymph cells on the superior surface of the nerve epithelium in the ampullæ), it may be that the pavement epithelium and also the cells of the recessus labyrinthi may have some effect upon the endolymph by a change of their contents, since they serve as a filter in the transudation and secretion of a similar material.

We know but little as to the chemical examination of the peri- and endolymph, and we must consider this only as a suggestion concerning these questionable substances.

Hagen<sup>1</sup> has furnished us a few analyses of serum from the external canal, which was collected after injuries of the head, complicated with fractures of the pyramid and tearing of the dura mater, and also of some only implicating the walls of the labyrinth. In the first, there was liquor cerebros spinalis; and in the second, fluid from the labyrinth.

While the former contained only traces of albumen, the latter had more of it, with a small admixture of chloride of sodium. Of course, we cannot determine, in such cases, whether we have peri- or endolymph or both mixed together. If we compare his results with those of Dänhardt,<sup>2</sup> which were derived from the codfish, the larger quantity of albumen must have come from the perilymph, as the endolymph, according to him, contains only traces of it. According to Dänhardt and others, notwithstanding the thinness of the membrane which separates them, only a slight diffusion takes place from the one to the other. Besides these peculiarities, both fluids are alkaline and contain mucin, chloride of sodium, and traces of sulphate and phosphate of lime.

If we wish to associate the presence of the little bodies with these conditions, the chalk would certainly have some

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<sup>1</sup> The serous exudation from the external ear after injuries of the head. Dr. R. Hagen, Leipzig, 1866.

<sup>2</sup> Endolymph and perilymph. By Dr. med. Dänhardt, from the Physiological Institute in Kiel, 1868, p. 103.

relation to them. The formation of the otoliths must have its origin in a separation of chalk, which may not be present in such small quantities as the analyses seem to indicate.

The deposit of phosphate of lime, which happens so frequently in the region of the acoustic nerve and within the coverings of the aqueducts, seems to indicate a disposition of the soft parts in the interior of the pyramid of the temporal bone to form chalky deposits.

On account of the reaction to osmic acid, we may suppose that these small bodies, before mentioned, have some relation to fat, but we must supplement this opinion until we have decisive evidence of the presence of fat in the endolymph of the human ear.

As to the place of formation, the evidence is that they are produced within the nucleus and not in the protoplasm of the cells. Many nuclei seem to have lost their homogeneous condition and become finely granular, and in many cells only the small globules were present. In all probability a continuous destruction and regeneration of nuclei and cells occurs, though in a manner hitherto unexplained, for nowhere could I demonstrate a division of nuclei which Fleming describes as indirect nuclear division, and the occurrence of which might be expected from the ectodermal origin of these epithelial cells.

#### *Explanation of Figures.*

Fig. 5. *a* and *b*. Epithelial cells from the second convolution of the cochlea. *c* and *d*. Epithelial cells from a membranous semicircular canal. *e*. Epithelial cells from the utricle.

# EPISTAXIS, PLUGGING OF THE NARES, AND THEIR RELATIONS TO AFFECTIONS OF THE ORGAN OF HEARING.

BY ARTHUR HARTMANN, OF BERLIN.

Translated by ISIDOR FURST, of New York.

IN submitting my experience with epistaxis to a discussion in the present paper, I do so, because I gather from the literature before me that many observed facts have not been sufficiently heeded, and that many relations have not been thoroughly elucidated.

The views which I have gained I would summarize thus:

1. The majority of spontaneous nasal hemorrhages spring from the anterior part of the nasal cavity, either from the septum or from the floor of the nares.

2. It is always possible either to find the bleeding spot or at least to determine from which part of the nose the hemorrhage flows.

3. To stop the hemorrhage it suffices, if the bleeding spot has been found, to press a small pledget of cotton upon it. If it be only possible to determine from which part of the nares the hemorrhage sprang, it suffices to plug the nasal meatus firmly with cotton.

4. By this partial tamponade directly applied to the bleeding spot, the hemorrhage is more certainly arrested, and in a manner less disagreeable to the patient, than by the anterior and posterior nasal tamponade, or by the filling of the entire nasal cavity.

5. By the posterior nasal tamponade, with or without employment of liquor ferri sesquichloridi, violent inflammations of the middle ear are not infrequently produced.

It is customary to distinguish two forms of spontaneous epistaxis: the *active* form referable to congestive, and the *passive* form referable to stasis, hyperæmia. Aside from the fact that this distinction cannot be applied to all cases, it appears to me more important, practically, to found the division, in the first place, upon the morbid dispositions which favor the occurrence, especially of the frequently-repeated, habitual epistaxis. The most important form of epistaxis, which, for simplicity's sake, we designate as dyscratic, is that in which we assume an *abnormal friability of the vessel walls*, which perhaps is connected with a decreased coagulability of the blood. Such conditions, we find particularly, in young, delicate individuals with pale complexion who have a phthisical tendency. While, in these, epistaxes are not rare up to the time of puberty, later, the far more dangerous hæmoptyses take their place. Furthermore, we have as belonging to this group, the tendency to epistaxis in weakened organisms, after grave diseases, in cachexiæ, in scorbutus, in malaria. This form of epistaxis exerts a very unfavorable influence upon the vigor of those suffering from it, and thereby the disposition to the repetition of the hemorrhage is favored.

Less grave are the hemorrhages which occur in vigorous persons of full habit, whom we designate as plethoric. These prove in many cases even of beneficial influence, and we must abstain from interfering with them. The hemorrhages may ensue both in acute and in chronic plethora, when large quantities of fluids are drunk, and by their absorption into the vascular system the lateral pressure in the vessels is increased; or, in chronic plethora when this pressure is permanently increased.

In both categories of patients, the disposition being present, the immediate inclination to the hemorrhage may be caused by congestion of the head, and the hemorrhage may be produced by all the influences which may incite that condition. In plethoric individuals particularly, not

rarely signs of cerebral congestion precede epistaxis,—pressure and oppression in the head, headache, vertigo. With the onset of an abundant hemorrhage, these phenomena disappear.

Furthermore, we must here mention the cases in which *mechanical obstacles prevent the flow of blood* from the superior vena cava to the right heart, and the stasis in the veins of the pituitary membrane favors their rupture. This is especially the case in diseases of the lungs and heart.

The epistaxes which are produced by *traumatic* causes seldom take on a threatening character; more frequently in injuries to the vessels caused by operative manipulations in the nose, the hemorrhages must be arrested by artificial means in order to avoid dangerous loss of blood.

Of importance are also the *epistaxes* which are found in *malignant neoplasms and ulcerative processes*. The former are generally unimportant, but occur very frequently; more or less blood being present in nearly all the discharged secretions. More profuse hemorrhages occur in ulcerative processes, in scrofulous, tuberculous, syphilitic ulcers, when the vessels become eroded.

The occurrence of hemorrhages from the nose as a *vicarious menstruation*, is designated as *vicarious epistaxis*.

Of the greatest rarity are cases of *intermitting epistaxis*, in which the hemorrhages occur at regular intervals, usually daily. These cases must be attributed to malaria, and can be cured by appropriate treatment.

Besides the cases of epistaxis just discussed, there is still another series, in which we can find no cause for the occurrence of the bleeding, and I believe these are the more frequent and more dangerous cases. Persons otherwise in perfect health, without any direct cause, are attacked by violent epistaxis, which is repeated after longer or shorter intervals, and which may become dangerous through the quantity of the blood lost.

#### *Origin of the Hemorrhages.*

The question of especial importance as regards treatment—from which parts of the nose the most violent, the most



threatening hemorrhages spring—has not yet been satisfactorily answered, and the reported observations are still scanty. Little<sup>1</sup> states that in four cases he found erosions upon the septum narium, close behind the meatus. Of two hemorrhages reported by Michel,<sup>2</sup> one sprang from a part of the septum, exactly above the anterior end of the inferior turbinated bone. The other hemorrhage originated quite in front at the entrance to the osseous naris, close above the floor, on the septum. In a case of epistaxis from both nostrils, I succeeded in discovering as the source of the hemorrhage two spots, likewise upon the anterior part of the vomer, situated symmetrically on both sides, which showed an irregular, excoriated surface contrasting with the otherwise quite smooth mucous membrane. Another hemorrhage which I had the opportunity of examining during its progress also issued from the anterior part of the septum. In two other profuse hemorrhages, I found the bleeding spot at the transition of the vomer into the floor of the naris. In still another fifth case the floor of the naris gave origin to the epistaxis. From this experience had by others and myself, I believe myself justified in drawing the conclusion that *the vomer and the floor of the naris pre-eminently participate in spontaneous epistaxes, and that the turbinated bones with their cavernous tissue rarely give origin to them.* As the mucous membrane of the septum and of the floor of the naris, is firmly attached to the underlying bone, it appears probable that the hemorrhages which take place from the vessels coming to the surface out of the bone, as well as those from the bone itself, are stopped with difficulty, because these vessels are surrounded by unyielding tissue which prevents their contraction, and that the intractability of these hemorrhages is due to this circumstance.

In isolated cases, these epistaxes might be caused by circumscribed dilatations of the vessels in some parts of the Schneiderian membrane, which, being liable to break by the slightest circumstance, give rise to the profuse hemorrhage.

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<sup>1</sup> *Hosp. Gazette.*

<sup>2</sup> *Die Krankheiten der Nasenhöhle und des Nasenrachenraumes*, Berlin, 1876, p. 71.

In favor of the occurrence of such places we have the observation of Voltolini,<sup>1</sup> who, on examining a patient suffering for six months from profuse epistaxes, found a teleangiectatic proliferation "deep in the nose" (the precise spot is not given), which he destroyed by the galvano-cautery, and thus permanently cured the trouble.

*Diagnosis of the Point of Origin of the Hemorrhages.*

In order to detect the source of the epistaxis, it is necessary, in the first place, to thoroughly dilate the nostril from which the blood is flowing, with some one of the usual specula,<sup>2</sup> and to illuminate the cavity well by the frontal reflector. The fluid and coagulated blood present having been removed by blowing the nose or by irrigation, a plug of cotton is introduced into the lower meatus with the bent tweezers, for the purpose of absorbing the blood still covering the surface of the mucous membrane. If the source of the hemorrhage is not found here, the middle meatus is treated in the same manner. In most cases the bleeding spot will then at once be seen, particularly if it is situated in the anterior part of the nose, which, as we have seen, seems to be most frequently the case. If the hemorrhage is more deeply situated, or, if profuse, and the surface of the mucous membrane is, immediately after the removal of the cleansing tampon, again covered with blood, a more systematic manipulation is required. In these cases I first remove the blood from the middle meatus; if thereafter it remains free from blood, it follows that the hemorrhage springs from the lower meatus; if, however, the mucous surface is quickly again covered with blood, the source of the hemorrhage must be sought in the upper part of the nose. During these examinations it is necessary to proceed as rapidly as possible, so that the inspection may be made immediately after the wiping. In order to prevent the subsequent flow of blood from hindering the examination, the

<sup>1</sup> *Monatschr. f. Ohrenheilk.*, Bd. xi, p. 51.

<sup>2</sup> For this purpose I employ an instrument named after Kramer; it is bivalved, resembles the otoscope, and is provided with a dilating mechanism. It appears to me to have many advantages over Duplay's speculum, which is ordinarily much used.

patient is directed to inspire abruptly with closed mouth, whereby the blood is made to course backward instead of forward. Whether the bleeding spot will be found in the more posteriorly situated regions depends on the width of the naris and the profuseness of the hemorrhage. If the spot cannot be found, it suffices to know from which nostril the hemorrhage springs, and whether from the anterior or posterior part of the nose.

A view differing from those just described is expressed by B. Fränkel,<sup>1</sup> who thinks that in many cases great difficulty is experienced in determining whether the hemorrhage springs from the naso-pharyngeal space, or from the posterior or other parts of the nose. "In the more violent hemorrhages it is nearly always impossible, on account of the blood quite inundating the field of view, to perform rhinoscopy, or to determine the bleeding spot by inspection from in front."

Should the patients come under observation after the epistaxis has ceased, there are frequently no indications for determining the source of the hemorrhage. If but a short time have elapsed since the epistaxis, black coagula are found, after the loosening of which by the probe the flow commences afresh. Michel, in one case, found only a punctiform particle of coagulated blood, and when it was touched with the probe profuse hemorrhage immediately ensued. I observed in two cases a like condition. The parts around these spots are perfectly normal. After the coagulum is removed, either an entirely smooth mucous membrane is seen, or the spot from which the blood issued is revealed as a minute depression.

### *Arrest of the Hemorrhage.*

The number of agents by which epistaxes may be arrested is exceedingly large—the application of cold in various forms, and the most widely differing astringent and styptic agents; among the latter, especially liquor ferri sesquichloridi, of which I shall speak further on. A great

<sup>1</sup> V. Ziemssen's *Handbuch der spec. Pathologie und Therapie*, Bd. iv, p. 148.

number of hemorrhages can be stilled by these more simple means; but there still remain many grave epistaxes in which they prove futile, and as the most reliable means for arresting these, plugging of the nares is generally employed.

Inasmuch as every hemorrhage is most certainly arrested by searching out the bleeding vessel, and applying our means to act directly upon it, this principle will likewise have to be extended to epistaxes; in every case the source of the hemorrhage must be looked for and directly operated upon.

According to my experience, it is sufficient for the arrest of all epistaxes to press a tampon of ordinary von Bruns' cotton for several minutes upon the bleeding spot, and to let it remain for twenty-four hours. In this manner I succeeded, under the most adverse circumstances, on a *canal boat*, by the flickering light of a petroleum lamp, to immediately arrest a hemorrhage in a man suffering from malaria, which had continued for two days, and had produced a condition of extreme anæmia. Solution of chloride of iron and other means had already been employed in vain. Although, on attempting to cleanse the nares with tampons of cotton, the hemorrhage flowed still more profusely, I yet succeeded in locating its source on the floor of the naris. I then introduced a pledget of cotton the size of a hazelnut, pressed it with a thick probe against the floor of the naris, and the flow immediately ceased. The next day the tampon was removed without the recurrence of the epistaxis. In a similar manner I succeeded in several other cases, in which the hemorrhage sprang from the anterior part of the nose. In epistaxes, from the anterior upper part of the septum, which are not rare, it sometimes suffices to push a small tampon behind the dorsum nasi, and to press it from without through the ala against the septum in order to arrest the flow at once.

If the bleeding spot has not been found during the examination, but only that part of the nose from which the epistaxis sprang, a piece of cotton dressing is so formed and compressed as to make a cylinder of 3 to 5 *cm.* in length,

the thickness ranging from that of a lead pencil to the little finger. This cylinder is to be inserted into the respective nostril with the tweezers, after the removal of which it is to be put in place with the probe. If the lower meatus is to be tamponed, a thick probe is to be pushed up above the cylinder, by which it is pressed against the floor of the naris, and, according to circumstances, either more toward the outer or inner wall of the passage. If the upper passage is to be plugged, the tampon is to be brought into it, and the probe pushed up below the cotton cylinder, which is to be pressed upward or outward. If one cylinder is insufficient to fill the passage, a second one is inserted in the same manner. If the naris is very wide, or the concha is far apart from the septum, the cylinders can also be inserted from the lower into the upper duct, and *vice versa*. The same is required when the septum is crooked, or when the lower turbinated bone projects strongly in some places; the tampon introduced above the constricted spot must be pressed downward behind it.

In most cases it suffices to arrest the hemorrhage, and no other measures are required. In order to prepare them for the recurrence of the flow, I instruct the patients how to introduce a tampon into the nose, recommending them to insert a small tampon of appropriate size, the tip of the nose being pressed upward, as straight as possible backward into the passage from which the blood issues, if need be with the aid of the tweezers, or a knitting-needle, and then to press the tampon—in hemorrhages from the anterior part of the septum—against it by pressure upon the ala; or, in those from the floor of the naris, to press the tampon downward from above with the closed tweezers or the knitting-needle. Besides, astringent solutions or solutions of chlorate of potash are ordered for the after-treatment. In habitual forms of epistaxis, constitutional anomalies must be regarded in the first place; secondly, pathological alterations possibly present in the nose have to be removed. The spot from which the blood issues should be destroyed by the galvano-cautery, so that a firm cicatrix be formed. Care must be had that red heat only is



employed, because with white heat the scab is torn off when the cautery is removed, and thus fresh hemorrhage is likely to occur.

Most authors who have treated of epistaxis in text-books of surgery or in special treatises, confine themselves to the description of the anterior and posterior nasal tamponade. Besides, the application of the rhineurynter is always fully discussed,—an instrument described as early as 1839 by Velpeau, after Martin Saint-Ange, and recently rediscovered by Küchenmeister<sup>1</sup> and drawn from its well-merited oblivion.

In English literature particularly, nearly every year clinical cases of epistaxis are reported, and the most heterogeneous medicaments are recommended. From among these communications I shall only specify the procedure described by Hamilton,<sup>2</sup> which consists in filling the entire half of the nose from which the hemorrhage issues, with strips of lint. The employment of this procedure may be particularly recommended to those who are less familiar with the examination of the nose, and who are not supplied with the instruments necessary for the partial tamponade.

#### *Advantages of the Partial Nasal Tamponade.*

As in the above-described mode of plugging the dressing cotton is pressed upon the actual bleeding spot, the hemorrhage is most certainly arrested. At least, I always succeeded in immediately stilling the flow in this manner; in but a single case, to be mentioned below, of artificial hemorrhage, I was obliged, by the seat of the bleeding spot, to perform the posterior tamponade.

Moreover, this method is the most agreeable to the patient, as there are none of the troublesome phenomena connected with the posterior nasal tamponade and the application of chloride of iron. In the posterior tamponade, the mere presence of the tampon in the naso-pharyngeal space is most distasteful to the patient, not to speak of the

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<sup>1</sup> *Oesterreichische Zeitschr. f. pract. Heilk.*, No. 22, 1871.

<sup>2</sup> *Brit. Med. Journ.*, May 8, 1880.



thread led outward through the mouth. The complete plugging prevents the discharge of the nasal secretions, great irritation of the mucous membrane ensues, and the passage of air is effectually prevented—evils not connected with the partial tamponade. After complete plugging of the nose (anterior and posterior tamponade) Bardeleben<sup>1</sup> twice observed blood issuing from the lachrymal ducts, without any evil effects, however, since it remained in the lachrymal apparatus.

As regards the employment of solution of chloride of iron, it is in universal use; for instance, the author of the section on epistaxis, in the just issued Real-Encyclopædie by Eulenburg (Nos. 41 and 42), in discussing the nasal tamponade, thus expresses himself respecting the saturation of the tampon with styptic fluids, especially with liquor ferri sesquichloridi: "Little can be said against it," without mentioning what objections could be made to its use. I, however, feel called upon to emphasize the fact that the drug produces great irritation in the mucous membrane, that it causes pain and subsequent inflammation. As a tampon soaked in solution of chloride of iron enters into firm connection with the underlying structures, a fresh hemorrhage is frequently produced by its removal, while the ordinary dressing cotton, directly applied, absorbs moisture, and is therefore more easily separated from the underlying tissue.

The ill effects which may be produced upon the auditory organ, by the nasal tamponade, especially when performed with solution of chloride of iron, have not hitherto been mentioned.

*Acute Inflammation of the Middle Ear A Sequel of the Posterior Nasal Tamponade.*

After performing the posterior nasal tamponade, with or without solution of chloride of iron, not infrequently violent inflammations of the middle ear occur, which are either caused by the inflammation set up by the acting irritation being propagated to the mucous membrane of the tubes, and from there to the middle ear, or perhaps by the en-

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<sup>1</sup> *Lehrbuch der Chirurgie*, Bd. iii, p. 199.

trance of some of the iron solution into the drum cavity, thus lighting up the inflammation.

The first case which came under my observation, occurred in a woman who was under my treatment for chronic otorrhœa conjoined with complete destruction of the membrana tympani. The history showed that the posterior nasal tamponade had been performed upon the patient on account of a very profuse hemorrhage from the nose. By the next day a pricking sensation was felt in the ear, which rapidly changed into violent pain. The inflammation became so great that the patient had to be treated for four weeks in one of our hospitals, suffering from high fever and most severe pains in the ear and head. Upon examination, several weeks after the otitis had run its course, I found the naris very wide, about as in ozæna; the entire inner surface of the nose, of the naso-pharyngeal space, and the openings of the tubes, could be seen.

Under these circumstances it certainly would have been possible to find the source of the epistaxis, and to arrest it in the above-described manner, thus saving the patient the grave otitis, and the consequent greatly impaired hearing.

A second case of severe otitis media, with transient cerebral symptoms, incited by the posterior nasal tamponade, occurred in a brother physician, X. Without demonstrable cause, very violent epistaxis from both nostrils had set in; the ordinary hæmostatics, such as ice, vinegar, tampons of chloride of iron, having failed, bilateral posterior tamponade, without employment of solution of chloride of iron, was performed at one of our hospitals. Three days after the tamponade, when I saw the patient, violent pains in the left ear had commenced, the membrana tympani appeared blue-black, as in effusions of blood; at its lower part was a small accumulation of dark blood with pulsating light reflex. In the next few days a serous, later a sero-purulent, discharge began from the ear. The pains were especially severe at night, with high fever and temperature above  $40^{\circ}$  R. On the fourth day of the affection, there occurred, together with a sensation of cerebral hyperæmia, intense vertigo, violent vomiting, mental hebetude, and loss of appetite. Temperature moderately increased to  $38.2^{\circ}$  R.; pulse normal. Ice bladder to the head. These cerebral symptoms again vanished during the next few days. The ear-

ache likewise soon decreased ; particularly after each employment of Politzer's experiment with slight pressure an improvement was always apparent. The hearing, at first much reduced, also quickly improved. On the twelfth day of the affection, after an error in diet, a relapse of the pains with diminished hearing occurred, but the application of three leeches soon caused the exacerbation to yield. Improvement progressed rapidly thereafter. Cure with complete restoration of hearing.

The hemorrhages in this case had sprung from the anterior part of the vomer, on both sides of which existed, at the height of the inferior turbinated bones, the above-mentioned excoriated spots, with irregular surface. After the first severe epistaxis had been arrested, fresh hemorrhages repeatedly recurred, but they were always speedily stilled by the patient inserting a plug of cotton into that part of the nose, and exerting pressure from without upon the bleeding spots. A careful examination of the nares during the first hemorrhage would certainly have discovered the source, and it might have been arrested in the same simple manner, thus obviating the posterior tamponade with its attending severe otitis media.

In a third case I observed violent otitis media after artificial hemorrhage, *i. e.*, occurring after an operation in the nose, which I had arrested by the posterior tamponade.

The case occurred in a patient who had placed himself under my treatment for chronic coryza, with occlusion of the nose. Examination showed bilateral, diffuse, polypoid hypertrophy of the inferior turbinated bones, thus completely occluding the lower meatuses. On rhinoscopic examination, both choana were to a great extent likewise found filled with swellings. I began to remove the tumors of the inferior turbinated bone from the anterior nares, partly with the hot, partly with the cold wire snare. After I had completed the removal of the neoplasms in the anterior part of the nose, I discovered on the left, in the most posterior part of the nose, a polypus of about the size of a hazel-nut, which filled the choanon, and could easily be moved to and fro with the sound. The space was too narrow for the double tubes of the galvano-caustic snare ; I therefore seized the cold wire, and with it removed the polypus. After that air could freely pass through that part of the nose, and the rhinoscopic examination proved

that the polypus had originated from the posterior end of the middle turbinated bone. After its removal a moderate hemorrhage ensued, which was controlled by the insertion of a plug of cotton into the middle meatus. In the evening I was called with the message that there was continual hemorrhage. I found on examination that the blood was steadily trickling down from the naso-pharyngeal space into the lower part of the pharynx. As the patient lived in a remote part of the city, my aim was to stop the hemorrhage positively for the night, and I therefore resorted to the posterior tamponade,<sup>1</sup> dipping the plug into a saucer of water to which I had added a few drops of liquor ferri sesquichloridi. The tampon being applied directly to the bleeding spot, the hemorrhage ceased at once. The plug was removed the following noon. At this time already the patient noticed a stinging sensation in the ear, and examination showed slight injection of the vessels of the drum-head. The symptoms thereafter rapidly increased in severity, and a very violent otitis media developed, which I at first tried to limit by the application of cold and three leeches. I was compelled to perform paracentesis of the membrana tympani, with but little effect; the application of hot sponges, however, proved very advantageous, they alone being able to quiet the severe pains. While the otitis media was running a favorable course, erysipelas set in at the leech bite, and migrated over the whole head; it was accompanied by high fever and other grave disturbances, but terminated favorably.

On summarizing the above observations, we may say, as regards the arrest of the hemorrhage in the first two cases, that the posterior tamponade might have been avoided, while that could hardly be done in the last case. In all cases the posterior tamponade produced severe inflammation of the middle ear.

From my experience I believe myself justified in drawing the conclusion, *that the posterior tamponade should be avoided, if the seat of the hemorrhage makes this possible, and especially should the application of liquor ferri sesquichloridi be eschewed.*

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<sup>1</sup> The tamponade was performed with the aid of an aural catheter, through which a loop of steel wire was pushed. When the loop appeared under the velum palati, it was seized with the dressing forceps, and drawn outward. The thread end of the tampon was then brought into the snare, and with it was drawn through the nose, then the tampon was brought into the naso-pharyngeal space by the thread. This procedure appears to me simpler than the employment of Bellocq's canula.

## AN ABSTRACT OF THE PAPERS ON OTOTOLOGY

READ BEFORE THE SECTION OF OPHTHALMOLOGY, OTOTOLOGY, AND LARYNGOLOGY, AT THE 32D MEETING OF THE AMERICAN MEDICAL ASSOCIATION, HELD AT RICHMOND, VA., MAY 4, 5, AND 6, 1881.

BY SWAN M. BURNETT, OF WASHINGTON.

In a paper on the *radical cure of nasal catarrh* Dr. W. C. JARVIS, of N. Y., related two cases in which great impairment of hearing was relieved by the instrumental removal of hypertrophied tissue of the turbinated bones. In one case the hearing was reported to be completely restored, although there was no direct treatment to the ear.

Dr. J. A. WHITE, of Richmond, had used Dr. Jarvis' instrument several times, and had found in some cases marked improvement in hearing after the relief of the anterior nasal troubles. In one case there was on one side no discoverable organic change in the *Mt.* or drum cavity after five years of disease, though there had been much impairment of hearing.

Dr. W. H. DALY, of Pittsburgh, had often found the hearing improved after the removal of nasal hypertrophies, and where there had been no direct treatment of the ear. To these hypertrophies he had sometimes applied the galvano-cautery by passing the electrode heated to a cherry-red over the growths. He had also used glacial acetic acid, applied to the base of the growths, with good effect.

In reply to a question Dr. JARVIS said he thought the trouble in the vault and pharynx in such cases secondary to the anterior nasal disease.

Dr. RISLEY, of Phila., had been struck with the frequent connection between nasal and aural diseases. He called particular

attention to deflection of the vomer as a cause of aural disease. He had not found it necessary to operate in such cases, but had treated them topically with iodoform and alum.

Dr. LITTLE, of Phila., called attention to the influence of nasal troubles on the lachrymal apparatus.

Dr. REYNOLDS spoke of the predisposing and constitutional causes of nasal affections.

Dr. CHISOLM, of Baltimore, described a *twitching of the tensor tympani muscle causing an annoying tinnitus*, as he had observed it in his own person. It was confined to the right ear, and consisted of a note rapidly and rhythmically repeating itself with perceptible intermissions between each individual sound. He found by experiment that he could produce the subjective sound, at that particular time, at will, by taking claret at dinner. Valsalva's method of inflation, Politzer's, and the throwing of chloroform vapor into the drum cavity, had no influence on the noise. Hearing power not influenced in any way. He has since seen two other cases. He considers them all due to a twitching of the tensor tympani muscle.

Dr. S. M. BURNETT, of Washington, called attention to a recently published case by Gottstein in which subjective noises were associated with spasm of the orbicularis, and which were referred to associated spasm of the stapedius. In this connection he wished to call attention to a physiological phenomenon which he had been observing for some years. He noticed that at times when he made a vigorous contraction of the orbicularis there was at the same time observed a roaring in the ears. He had found the best time for making the experiment to be in the morning immediately after waking.

After making three or four vigorous contractions of the orbicularis, the phenomenon ceased. He was in doubt whether to refer it to the noise of the muscular contraction conveyed to the auditory nerve through the cranial bones, or to a simultaneous contraction of one of the two intra-aural muscles. As this noise was exactly similar in character to that caused by muscular contraction in other parts of the face, especially the muscles of the lower jaw, he was inclined to refer it to this source.



## QUARTERLY ABSTRACT OF AMERICAN OTOLOGICAL LITERATURE.

BY DR. SWAN M. BURNETT, OF WASHINGTON.

1. On the metastasis of inflammations from the ear to the brain. By J. A. ANDREWS. *New York Med. Jour.*, February and March.

An elaborate consideration of the subject, giving a *résumé* of our knowledge of such inflammations as gleaned from the literature of the question. No original observations are given.

2. Nasal, post-nasal, supra-post-nasal and pharyngeal inflammations, considered with reference to diseases of the middle ear. With remarks upon treatment. By C. S. TURNBULL. *Med. and Surg. Rep.*, Feb. 19th.

3. Foreign bodies in the ear. By C. H. BURNETT. *Amer. Specialist*, March 1st.

B. thinks that, as a rule, foreign bodies in the ear do less harm than the unskilful efforts to extract them. He still clings to the syringe as the safest and best means for removing the majority of foreign bodies which find their way into the ear.

4. Malarial otitis. By F. C. HOTZ. *Amer. Specialist*, March 1st.

H. records another case of otitis intermittens which showed in a remarkable manner the intolerance of the ear to any local application, even gentle injection of warm water producing a fainting fit. Cured by quinia.

5. Perichondritis auricular. THOS. R. POOLEY. *N. Y. Med. Record*, March 19th.

P. relates a case of this affection which bears a close resemblance to the one reported by Dr. Knapp in vol. ix, No. 3 of these ARCHIVES.

REPORT ON THE PROGRESS OF OTOLOGY  
DURING THE SECOND HALF OF THE  
YEAR 1880.

(CONCLUSION.)

Translated by Dr. Richard C. BRANDEIS, New York.

I.—PHYSIOLOGY OF THE EAR AND PHYSIOLOGICAL  
ACOUSTICS.

By OSCAR WOLF, FRANKFORT-ON-THE-MAIN.

1. A. BOCKENDAHL, Kiel. The movements of the tensor tympani muscle as observed in the dog. *Archiv f. Ohrenh.*, vol. xvi, part 4.
2. ALEXANDER GRAHAM BELL. The photophone. Address delivered before the American Association for the Advancement of Science. Boston.

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1. BOCKENDAHL has continued the experiments begun by Hensen for the purpose of determining the functions of the tensor tympani muscle. As Hensen has proved that the tensor tympani contracts at the beginning of a tone, sound, or syllable, Bockendahl set to work to find a method to determine exactly the dimensions of the muscular movements as well as the influence of the variations in pitch and intensity of tones, and their mode of action upon the membrana tympani.

Hensen, as is well known, after exposing the tympanic cavity of a cat or dog, inserted a needle into the belly of the muscle, and then allowed different tones to reach the membrane. In order to determine how great the excursion was which was due to a contraction of all the muscular fibres, Bockendahl attached instru-

ments, which could register these movements, to the osseous insertion of the muscle, or at least to its tendon.

We first find a description of the manner of opening the tympanic cavity of the dog from the *bullæ ossea*. This is a rather difficult and complicated operation, the details of which can best be found in the original paper. It need only be said that the skin is incised in a line parallel with the lower maxilla, and equidistant from the angle of the lower jaw and the transverse process of the first cervical vertebra. The construction of the tympanum, which differs somewhat from that of the human subject, is discussed in detail.

The diminutive size of the parts, when compared with the instruments employed, gave rise to some difficulties during the experiments. The attempt to reach the muscle from within (through the trephined opening) in such a manner that the needle inserted into it had sufficient play to make the necessary movements, was not successful. After making vain attempts upon sixteen dogs, the experimenter determined to pass the needle into the body of the malleus, through the external meatus and the tympanic membrane, after removing the bony portion of the meatus. This proceeding has the advantage that the tympanic cavity need not be exposed. The body of the malleus, the manubrium, and the muscle, which is strongly developed in the dog, can now be seen through the membrane. The excursions made by the needle, which was bored into the malleus, were duly noted by means of the corneal microscope, which was brought to bear upon it; the length of the movements was determined by the ocular micrometer. Organ pipes, reed instruments, Hipp's apparatus, etc., were used for the production of sounds. The experiments showed, as was also Hensen's experience, that the excursions of the needle were in direct ratio with the pitch of the tones; the higher the pitch, the greater the vibrations. As the pitch of the tones diminished, the vibrations of the needle generally became less. Bockendahl determines the limits of sounds heard with implication of the tensor tympani muscle as ranging between 144 to 6,144 vibrations.

Tones of the seventh octave gave rise to the greatest excursions of the needle. The intensity of sounds was found to be very important, for, as a rule, the intensity required to cause contractions of the muscle was much greater than ordinary conversation. It was surprising that the contractions of the muscle were much smaller than was to be expected by analogy, from the equivalent

of the muscular force exerted by other muscles. The deduction which Bockendahl draws from his experiments, "*that the function of the tensor tympani muscle is virtually that of an apparatus to regulate the accommodation of the ear,*" is even more important. Contrary to Hensen's experience who, after every *new* sound, was able to detect movements of the needle inserted into the muscle, he is convinced that after every sustained sound (or noise) he noticed a cessation of motion after relaxation of the muscles. He is also convinced that the needle, which is set in motion by a sound does not return again to its original position when the sound is sustained, but while registering every vibration and impulse, only becomes passive when the sound has entirely ceased.

Bockendahl does not think that his experiments have settled the question at issue, but thinks that it will be the province of future experimenters to determine an accurate means of measurement. The reviewer cannot endorse all the conclusions concerning the office of the tensor tympani muscle during the act of hearing. If the author had passed a needle, or lever, through the membrana tympani and into the body or the muscular process of the malleus, as Politzer, Blake, Bezold, and others did in their experiments on the vibrations of the ossicula, and then had noticed movements corresponding with the sounds perceived, he still would not be justified in reaching any other conclusion than that the process moves in correspondence with the malleus and drum membrane. The very fact that even during the duration of a sound this process does not cease to move, goes to prove that these movements are caused by vibrations of sound. Facts pointing to the accommodation of the muscles are yet to be demonstrated.

2. The most recent invention of ALEXANDER GRAHAM BELL, the photophone, by means of which sound-waves are transformed into light-waves, and these again, by means of a sensitive apparatus of selenium, into electric vibrations, and these again transposed into sounds, by means of a telephone, is deserving of a brief notice. The German edition of the address gives us all important particulars concerning selenium and its peculiar properties. It remains to be seen whether the invention will become available as rapidly as the telephone. And this will depend upon the possibility of constructing the selenium cells in such a manner that they can be replaced readily. So far the difficulties are no less than those encountered by Edison in the construction of a cheap and durable electric lamp.

## II.—EMBRYOLOGY AND COMPARATIVE ANATOMY OF THE EAR.

BY L. LÖWE, BERLIN.

GUSTAV RETZUIS. Contribution to the knowledge of the ear of the vertebrata. His and *Braune's Archive*, 1880, Nos. 2 and 3, pp. 235-244.

A few years ago (1872), RETZUIS found a terminal portion of a nerve in the auditory labyrinth of the bony fish, situated in the utricle near its union with the sacculus. Two small nerve filaments, which come from the *ramus cochlearis*, pass to this terminus. Retzuis looks upon this as the first trace of the "pars basilaris cochleæ"; the branches of the nerves he called the rami partis basilaris cochleæ. However, Hasse, who confirmed the presence of these structures in the vertebrate fish, was not disposed to endorse this view.

Taken altogether, we gather from Retzuis, the terminus in question is neither the pars basilaris cochleæ, nor is it, as Hasse and others supposed in the case of the amphibii, "a first trace of the cochlea" (pars initialis cochleæ). In fact it is an unique structure, a peculiar and quite unusual terminal formation, which first appears in fish, and later is found, in its most highly developed state, in the amphibii, especially the anuræ, and in the reptiles again is stunted. In birds and mammals the traces of this organ become less and less until it is entirely lost in the crista acustica of the frontal ampulla, from which it probably originated by division. The names formerly borne by this organ, *i. e.*, pars basilaris cochleæ, or pars initialis, must, therefore, be discarded. But it is rather difficult to find a fitting name for it.

"Macula acustica utriculi posterior" would, in most cases, be a suitable name. Retzuis has chosen an indifferent title and calls it "macula acustica neglecta," in remembrance of the neglect with which it has so long been treated. The nerve branch belonging to it may fitly be called the ramulus neglectus. How is it about the morphological development of the most important part of the ear, the true pars basilaris cochleæ? As the formation just described does not correspond to it, it is proven that in fish we have no pars basilaris, but only the lagena cochleæ with its nerve terminus.

The amphibii are the first to show a trace of a true pars basilaris.

III—PATHOLOGY AND THERAPEUTICS OF THE EAR.

By A. HARTMANN, BERLIN.

GENERAL.

1. HEDINGER. Report of the Institute for the Treatment of Diseases of the Ear. Stuttgart, 1880.

2. WEIL. The results of an examination of the ear of 267 children in an institute. *Monatschr. f. O.*, No. 12, 1880.

3. E. D. SPEAR. Clinical observations. *American Journal of Otology*, vol. ii, p. 100.

4. SAMUEL SEXTON. A note of aural phenomena after poisoning by chenopodium. *American Journal of Otology*, vol. 2, p. 292.

5. S. MOOS, Heidelberg. A rare case of perforating wound of the left side of the skull, etc. These ARCHIVES, vol. 10.

6. ALBERT H. BUCK. Fractures of the temporal bone. *American Journal of Otology*, vol. 2, p. 264.

7. J. HUGHLINGS JACKSON. Lecture on auditory vertigo. *Lancet*, Oct. 2, 1880.

8. SAMUEL SEXTON. New aural instruments. *American Journal of Otology*, vol. ii, p. 298.

9. SAMUEL SEXTON. Hearing by aid of tissue-conduction. *American Journal of Otology*, vol. ii, p. 114.

10. VICTOR BREMER. The pathological results of the examination of deaf-mutes, especially in Denmark. Copenhagen, 1880.

11. Une fête des Sourds-muets. *Revue Médicale*, Dec. 4, 1880.

12. A. PAQUET. The surgical treatment of diseases of the ear. Lille, 1879.

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1. HEDINGER's report includes 2,931 patients. We will limit ourselves to the mention of a few points connected with the statistical analysis of the cases. In eczema of the auricle and external meatus, Hedinger has derived satisfactory results from the use of Pagenstecher's ointment. In discussing the diseases of the middle ear, the diseases affecting railway employés are carefully considered, and Hedinger agrees with the views advanced by Moos. In chronic catarrh (sclerosis) Hedinger thinks that the use of bichromate of soda and the oleum pini pumilionis affords some benefit. He also uses the vapor of iodine and chloral hydrate. A case is reported in which subjective noises were relieved,



after the removal of a chronic nasal catarrh with adenoid vegetation, by the insufflation of nitrate of silver, 1:3, without the use of the air douche. In a second case, similar results were obtained by the removal of a pharyngeal tonsil by means of the galvano-cautery. The use of the constant current was sometimes attended with most satisfactory results. Hedinger speaks at length of the diseases of the nose, the naso-pharynx, and their treatment, as well as of the importance of ear diseases in relation to life insurance and military service. In respect to the latter, Hedinger thinks that small perforations of the drum-head (not larger than a pea) ought not to unfit one permanently, as much as chronic catarrh of the middle ear. In conclusion, labyrinthine affections and the audiphone and dentaphone are considered.

2. WEIL examined 267 children in an institute in Stuttgart, in respect to their hearing power. Forty-four complained of ear-ache, and of these 20 had tinnitus. This latter symptom was found 48 times. Accumulation of cerumen was found in 35 cases, otorrhœa in 11. Eighty-one children (30.3 per cent.) had impaired hearing, were only able to distinguish the whispering voice at a less distance than 8 metres. The statistics show a large increase in the percentage of deafness corresponding with the increase of age. The great frequency of deafness in children having thus been demonstrated, Weil insists upon a careful examination of every sluggish and inattentive child.

3. SPEAR'S first case was that of a woman in whom a facial paralysis set in during the treatment of an otorrhœa complicated with polypi. Some time after a sequestrum, which embraced two of the convolutions of the cochlea, was removed through the external meatus. A second sequestrum contained a portion of the wall of the vestibule and of the upper and horizontal semicircular canals. Cured. The second case was that of an abscess above the mastoid process which developed during the course of an otorrhœa; pus was found only after the third incision, and was speedily followed by a cure. The fifth case was that of a patient who had fallen on his chin. The result was, besides the loss of several teeth, that the lower wall of the meatus was forced upward, thereby diminishing the calibre of the canal. The remaining cases present nothing of interest.

4. SEXTON adds another case to those previously published, of chenopodium poisoning, in which deafness also ensued. A careful examination was not made.

6. In fractures of the temporal bone, the solution of continuity generally corresponds with the sutures formed by the different parts of which it is composed, *i. e.*, the squamous, petrous, and tympanic bones, and these cases might properly be termed diastasis. Besides these there is a weak point in the middle of the petrous bone, where it encloses the internal meatus auditorius and the cavity of the labyrinth. BUCK describes 14 cases of fracture of the temporal bone in which recovery occurred, and classes them as follows : 1, Fracture or diastasis of the tympanic or squamous portion in the region of the middle ear, without implication of the petrous portion ; 2, fracture of both the pars tympanica and petrosa. Of the first he has seen three cases ; in none of these was the hearing impaired to any extent, and in all of them were the signs of fracture, in the immediate neighborhood of the membrana tympani, easily recognizable. In the next ten cases the tympanic and squamous parts were both fractured, in two of them from gun-shot wounds. In all of these cases deafness was complete ; this may be due either to a fracture, which passes through the labyrinth, or to a hemorrhage into the cochlea. In the 14th case, the deafness only ensued after the occurrence of a meningitis. As far as the diagnostic value of hemorrhages from the ear, after fracture of the base of the skull, is concerned, Buck believes that if there be a flow of blood we can only assume a fracture of the temporal bone in the neighborhood of Shrapnell's membrane, and, perhaps, in the Glaserian fissure. He reports a case in which there was no hemorrhage during life, but there was deafness, and the *post-mortem* showed a bilateral fracture through the middle of the petrous bone, extending upward to the roof of the tympanum. In reference to serous effusion, Buck infers from a case in which there was no deafness, that there was no fracture of the petrous bone, and that the discharge was simply the result of an inflammatory process. In conclusion, Buck discussed the appearance of facial paralysis after fractures of the temporal bone.

7. HUGHLINGS JACKSON gives us a very interesting account of aural vertigo. He differentiates it from epileptic vertigo, which arises as follows : A patient who has a mild attack of epilepsy, or in the beginning of a grave one, feels as if every thing around him were moving, or as if he himself were moving about. In aural vertigo he feels as if every thing around him were moving suddenly from side to side, or revolving on an axis. The uncertain gait

and the aggravation after moving the head are characterized, by Jackson, locomotor symptoms ; the sudden pallor, nausea, vomiting, the intense depression, headache, are vital manifestations. In every case, "the ear is at fault." The ear is affected, but it is evident that the locomotor and vital symptoms arise from some disturbance of the nerve-centres. Jackson has no doubt the ear is the *fons et origo mali* ; in harmony with Sydney Ringer's hypothesis as to the cause of migraine, Jackson believes that every thing which tends to impair health may be a cause of auditory vertigo. If the resistance of the nervous system is impaired, it will be the more susceptible to all sources of irritation arising from the ear. The vertigo is often attributed to gastric disturbances, but these are due to central disturbances. We are only justified in diagnosing auditory vertigo when there are aural symptoms, and whenever we meet with any attacks of vertigo we ought to examine the ear. Not every attack of vertigo, even though attended with symptoms of aural disease can be referred to that organ. There are attacks of epilepsy which begin with noises in the ear ; in some cases of epilepsy and of epileptiform attacks there is a preëxisting disease of the ear and a probable relation of cause and effect between the two diseases. These two affections are entirely different, and also differ from Ménière's disease.

In conclusion, chronic cases of auditory vertigo are briefly considered ; the vertigo is either constant or it is complicated by eczema.

8. SEXTON describes two new instruments ; a wire snare, in which the wire is fastened in a more complicated manner than in other instruments. The second is a forceps for the removal of foreign bodies ; the two branches of the forceps are retracted by means of a ring and in this way brought together.

9. SEXTON makes a few remarks about the value of the audiophone, and, in harmony with other writers, accords it a very subordinate rank, especially in those cases in which there is autophony, *i. e.*, hearing of one's own voice. Sexton believes that the majority of deaf-mutes hear their own voice, and that only these can acquire articulate speech. (If this were so there would be little difficulty in teaching them to speak.—REP.)

10. After giving us a very elaborate historical introduction, in which the older views on deaf-mutism, the methods of instruction, treatment, and the pathological-anatomical conditions are consid-

ered, BREMER presents a table of the results found in the examination of 303 deaf-mutes of the Institute of Copenhagen (Chap. ii). In 117, *i. e.*, 38.9 per cent., the result was negative, inasmuch as there were neither changes in the external ear, nor on the drum-head or the Eustachian tube. As far as the external ear is concerned Bremer found startling changes in two cases, once macrotia and once microtia. Uniform funnel-shaped contraction of the external meatus was found in 11 cases; thrombi and foreign bodies were frequently discovered. The most varied alterations were found on the drum-head; total or partial opacities, depression, calcareous deposits, destruction. In 97 cases Bremer found pharyngeal catarrh, and in 47 hypertrophy of the tonsils. In 34 cases catheterization was difficult. In Chap. iii, the pathological changes, which were found in a number of specimens of ear taken from deaf-mutes, are described. There are, however, no notes concerning the patients themselves. Thirty-three specimens are described, and of these we may mention: Malformation of the labyrinth in two specimens taken from the same patient; instead of a labyrinth we have a solid mass of bone. In another specimen there was a total absence of the semicircular canals. In two, taken from the same patient, the posterior semicircular canal was missing, and at the same time there was a fusion of the crura ampullaria of the other canals. The semicircular canals were often found filled with bony or calcareous masses—completely so, in 5 specimens (belonging to 3 patients), partially, in 10 specimens (taken from 7 cases). Absence of the septa of the cochlea was noticed in 6 specimens (3 cases); in four specimens there was a solid protuberance without any convolutions (in these the semicircular canals were filled with bone tissue); in one case the first convolution was filled with bone. Contraction or dilatation of the aquæductus vestibuli or the porus acusticus internus was repeatedly seen.

11. Is a description of an entertainment of deaf-mutes, in Paris, at which the addresses and a play were delivered in pantomime, although the subjects had been taught to articulate with some ease. The editor goes on to say that pseudoparole is not the immediate expression of thought, but only a labored translation, very limited and often unpleasant for the deaf-mute, and for those who must listen to it. We beg to say, however, that the deaf-mute, in acquiring speech, occupies the same relative positions which we do when we undertake to acquire a foreign

tongue. It does not suffice for us to learn a few words in order to speak and to understand this new language. If the deaf-mute is so taught that he commands the method in full, it will become a means of intercourse with others.

12. PAQUET restricts himself, in his monograph, to an enumeration of the usual methods of examination and modes of treatment in diseases of the ear, and fails to give us any original observations.

#### EXTERNAL EAR.

13. H. KNAPP, New York. Perichondritis auriculæ. These ARCHIVES, vol. x.

14. A. HEDINGER, Stuttgart. On a peculiar exostosis in the ear. These ARCHIVES, vol. x.

15. LUCAE, Berlin. Foreign bodies in the ear. *Real-encyclopædie der ges. Heilk.*, vol. v, pp. 45 and 46.

16. DE SAINT GERMAIN. Removal of a foreign body. Société de Chirurgie. *Progrès Méd.*, Nov. 13, 1880.

17. CHAS. H. BURNETT. Reflex ulceration in the external auditory canal, due to carious teeth. *Amer. Journ. of Otol.*, vol. ii, p. 285.

18. WEIL, Stuttgart. Cases of rupture of the membrana tympani. *Memorabilien*, No xi, 1880.

15. LUCAE writes of foreign bodies in the ear, and gives us the usual description of the methods of their removal, and the dangers which may ensue when attempts are made to extract them by means of surgical instruments. In addition to the cases in which there was a fatal issue, as reported by Weinlechner and E. Fränkel, he adds those of Levi, Wendt, and Moss.

16. DE SAINT GERMAIN reports the extraction of a china button from the ear. Syringing having proved futile, a small hook was passed into one of the numerous eyelets of the button, and it was thereby withdrawn.

17. BURNETT describes a case of ulceration of the external canal, caused by carious teeth. The ulceration was located on the posterior wall, and was complicated by a perforation of the drum-head. The trouble was repeatedly cured, but invariably returned, until it was found that on the same side of the mouth

there were carious molars. As soon as these were removed a permanent cure was established.

18. Among four cases of rupture of the membrana tympani, which were under WEIL's care, there was one in which there was a double rupture, due to the shock produced by the explosion of a torpedo thrown against the ear. In another case the rupture occurred during the act of urging, and in a third it occurred after an inflation of the ear by means of Politzer's method, and was followed by an improvement of hearing.



## SPECIAL REPORT OF THE CONTRIBUTIONS TO OTOLOGY IN ITALY IN THE YEAR 1880.

BY T. BOBONE, OF SAN REMO.

Translated from the German.

It is generally well known that very few writers on otology have as yet been found in Italy. The principal reason for this must be that, with the exception of the University in Rome, otology is not officially taught in any part of the kingdom. It is, therefore, readily understood that young physicians and students with us, only with difficulty interest themselves in this branch of study. All this may explain why the following report contains so little. We none the less hope that one of the most important results of the International Congress, held in Milan, in September, 1880, will be to increase the interest in this locality, for this branch of medicine.

I. E. DE ROSSI (Rome). IX anno di insegnamento della otoiatira. Roma, 1880.

This book of De Rossi's, containing only 55 pages, besides the statistics of the St. Giacomo Hospital's out-door patients in 1879-80, has some observations on the pathology and treatment of various diseases of the ear. The whole number of patients was 516, —310 males, 118 females, and 88 children.

In cases of foreign bodies in the ear, if these bodies were bits of wood or seeds, the author employed for their removal a peculiarly-constructed little hook. Injections, in such cases, De Rossi regards as useless or even as dangerous.

In acute myringitis, with hyperæmia of the middle ear, the author has found the air douche and instillations of lukewarm water very useful, and believes that paracentesis of the drum-heads is only exceptionally needed.

De Rossi suggests the necessity of a better classification of diseases of the middle ear, since they arise from various causes and demand various kinds of treatment.

Bezold's antiseptic treatment of suppurations of the middle ear has been found adapted only to the acute cases. In those cases in which the perforation of the membrana tympani, occurred near Shrapnell's membrane, the results were not so satisfactory.

Some results were obtained from the intra-tympanic injections of medicated fluids, in cases of hyperæmia of the middle ear, as well as in the so-called *otitis media hyperplastica*. De Rossi had the opportunity of examining a patient in whom, two years before, he had disarticulated the incus from the stapes. The improvement of hearing which resulted from the operation was retained.

Caries of the mastoid process was observed nine times. All of these patients were operated upon with antiseptic treatment. Seven recovered, one was improved, and one died.

2. Prof. G. BEZZI (Modena). Nuovo metodo curativo di alcune forme di sordità. Spallanzani, 1880, Nos. 1 and 2.

The so-called new method of Prof. BEZZI's consists in the condensation and rarification of the air in the external auditory canal, by means of an instrument invented by the author. The membrana tympani is made to move out and in by the changes in the pressure of the air. The advantage in this to-and-fro movement is in the increased mobility of the ossicles. Besides, the Eustachian tubes are rendered more easily permeable. As is well known, von Tröltsch, Moos, Siegle, Schwartz, Lucae, and others have long since recommended rarification of the air, and the condensation has been recently recommended by Gruber. The new (?) method by Bezzi, *i. e.*, the combination of condensation and rarification, has not as yet been tried upon patients by the inventor.

3. Prof. G. PALADINO (Naples). *Giornale internazionale delle scienze mediche*, 1880, fas 4.

Referring to the communications of American otologists in regard to the audiphone and the dentaphone, PALADINO calls attention to a paper of his, published in 1876, by which it will be seen that he was the first to make an instrument founded upon the principles of conduction of sound by bone, which is useful for diagnostic and therapeutic purposes.

This instrument was called the *Phonifero*, and consisted of a wooden or iron rod, with peculiarly formed terminal disks. One of these the deaf person holds between the teeth, while the other rests upon the region of the larynx of the speaker. The voice of the latter is carried directly to the teeth of the deaf person. The terminal piece may be placed upon the forehead, the occiput, or the mastoid process.

The advantage of this instrument, according to Paladino, is that the waves of sound are conveyed directly through the *Phonifero* and the bones of the head, to the acoustic nerve, and that they do not first pass through the air, as in the use of the audiphone and dentaphone.

4. Dr. BARGELLINI (Florence). L' audifono, l' elettrofono, ed i sordo-muti. *Gazzetta delle cliniche di Torino*, 1880, No. 36.

Together with a detailed description of Rhodes' audiphone and Clarke's electrophone, the author gives the results of the experience that he has had in the Institution for Deaf-Mutes in Sienna. He used four audiphones for his examinations, of which two were made of satin wood, *carton satiné* (Rhodes), one of wood (Dunn), and the fourth of zinc (Colladon). Experiments were made with three deaf-mutes. The first heard the audiphone as a noise, the second and third could repeat several vowel sounds. Other experiments that were made in the institute by Dr. Marchio showed that the audiphone could do good service, of course when the acoustic nerve is not completely paralyzed.

5. Dr. L. BONELLI (Turin). Otite media purulenta consecutiva a febbre teforde. *Gazzetta delle cliniche di Torino*, 1880, No. 44.

In a man, 27 years of age, in the St. Jean Hospital at Torino, who was being treated for typhus fever, a very severe pain in the right ear appeared with high fever, tinnitus, and deafness. Dr. Novaro performed paracentesis, by which a little pus was evacuated. The ear was syringed with carbolated water and stopped up with carbolated cotton. The pain quickly subsided. The temperature on the following day was normal. The hearing was restored.

6. Dr. E. GIAMPIETRO (Naples). *Giornale internaz. delle scienze mediche*, 1880, No. 8.

The writer remarks upon the condition of the membrana tympani, after paracentesis, and upon the causes which favor its rapid healing. These causes are found in the blood-vessels, which ex-

ist in abundance on that portion of the membrana tympani where the operation is usually performed. In order to maintain a permanent opening, the author advises that the operation be performed on the middle zone, where the blood-vessels are less numerous. He also describes his speculum, which is similar to that of Kramer. The two halves are a little curved, and end in a mouth 5 *cm.* long. When the instrument is closed the calibre of the speculum is  $1\frac{1}{2}$  *mm.* Two little buttons are found on the ends of the bivalved halves. A small needle, having a point like a trocar, passes through the tube. Its point is  $\frac{1}{2}$  *mm.* broader than the end of the speculum, so that the whole instrument has the form of a *trocár*. In using this instrument, the speculum is placed in the auditory canal in such a way that the point of the needle comes in contact with that portion of the membrana tympani which is to be perforated. The halves of the speculum are now separated from each other somewhat by a screw on the handle of the instrument, the needle is drawn out, while the end of the speculum remains in the opening that has been made. (?)

(The other writings of de Rossi, Grazzi, Ravogli, that have appeared in Italy in the last few years, have been noticed in our last reports on the Progress of Otology.—EDITORS.)



Fig. 1.

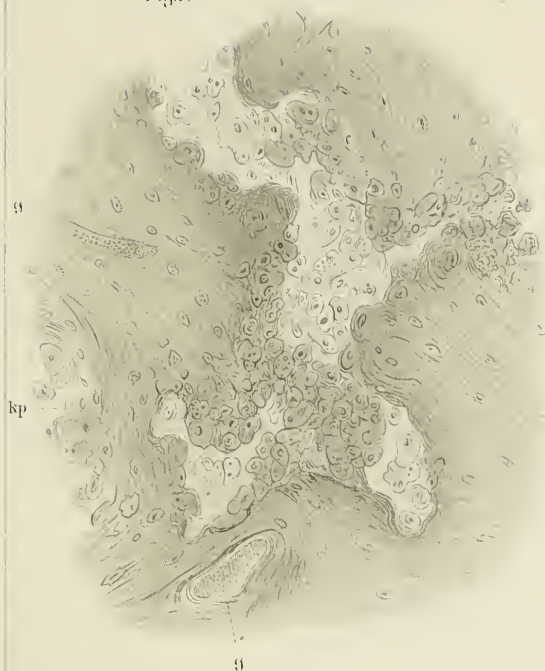


Fig. 3.

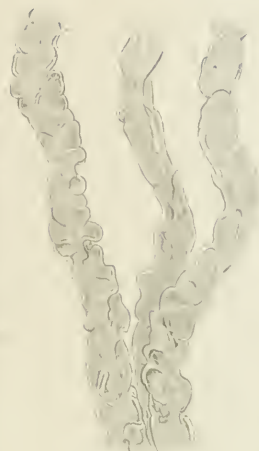


Fig. 2.

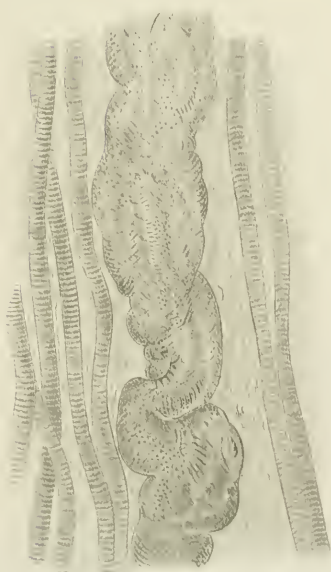


Fig. 4.







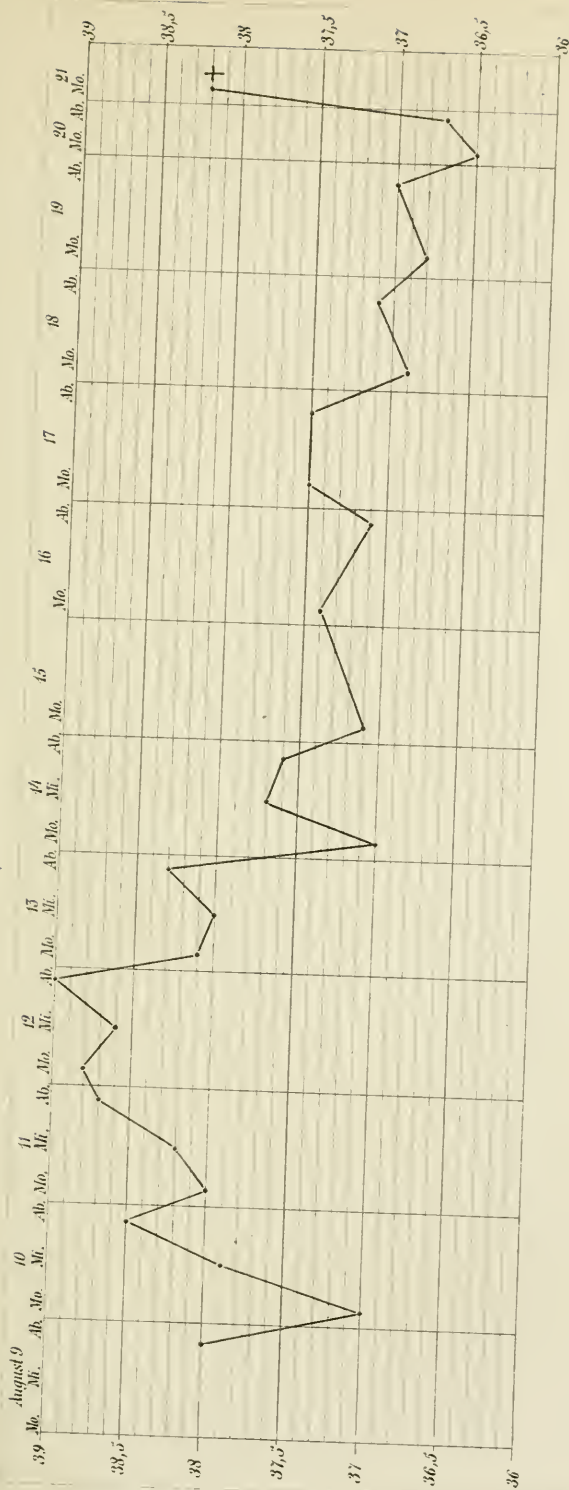


Fig. 5.



1871

## ARCHIVES OF OTOLOGY.

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### ON THE VALUE OF OPERATIONS IN WHICH THE MEMBRANA TYMPANI IS INCISED.\*

By D. B. ST. JOHN ROOSA, M.D.

ONE of the subjects that will be discussed at the coming meeting of the International Medical Congress in London, is that which I have taken as a title for this paper. On receiving the announcement it occurred to me that if the time and your convenience allowed, it would be proper for our Society to join in this discussion, and present to the profession our opinion as to the value of operations upon the drum-head.

We are all familiar with the early history of an operation which was first undertaken by Cheselden on the brute species, and continued successfully on the human subject by Sir Astley Cooper. We have all joined in the trial of attempts by galvano-cautery, eyelets, myringectomy, and acids, to maintain permanent openings in the membrane. We have also tested division of the tensor tympani, simple incisions followed by injections, excision of the malleus, repeated paracentesis, and, finally, we are all in the habit, as occasion may require, of evacuating mucus, blood, and pus by incision in subacute, and chronic cases.

But what has been the outcome of all this history? In what cases do we *now* recommend and perform operations that involve an incision of the membrana tympani? I am sure that the profession at large, both in this country and abroad, would consider our testimony on this subject of some value, for nowhere in the world is otology cultivated with

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\* Read before the American Otological Society, July, 1881.

more zeal, and, as it seems to me, with more knowledge, judgment, and skill than on this side of the Atlantic. I know of no way of getting at this discussion, if the Society feels disposed to enter upon it, than for each member to frankly state in what cases he at the present time is in the habit of incising the membrane, and also to give the reasons why he rejects other procedures than those which he adopts.

As for myself, I will say that I have given up all operations in cases of chronic proliferous inflammations, or, if you prefer the term, in chronic non-suppurative cases where there are perhaps adhesions between the ossicles, or between an ossicle and the promontory, and where there is no suspicion of retained mucus in the tympanic cavity.

I have finally rejected operations in these cases, because some experience of my own, in the way of division of the tensor tympani, insertion of an eyelet, attempt at maintenance of a permanent opening by means of incisions and frequent paracenteses, has convinced me that these operations are inadequate to relieve tinnitus aurium, improve the hearing, or retard the advance of a disease which as yet must be pronounced as hopelessly incurable as chronic non-inflammatory glaucoma, or atrophy of the optic nerves.

The experience of others, of whom I may mention Weber-Liel, Hackley, Simrock, Pomeroy, Hinton, Prout, some of whose cases I have been permitted to study as if they were my own, has only strengthened me in my conviction, that we are as yet without any operation which can rescue these cases from the awful category in which they, as it seems to me, have been placed.

When we enter the field of accumulations of mucus or pus in the tympanic cavity, cases that may be plainly made out by all of us, in most cases without a reasonable doubt, we have entered into a hopeful arena. Here paracentesis, *carefully performed*, and for the most part by far in acute or subacute cases, is, I think, a great addition to our means of cure. I do not, however, incise every bulging drum-head. I still regard paracentesis of the membrana tympani as an operation not to be lightly undertaken, and always to be

performed with gentleness. Necessary as may be the evacuation of mucus, it may often be removed, even with a little delay, by a thorough employment of Politzer's method of inflation, and by attention to the throat and nostrils, and an operation by incision be avoided. Red as may be a drum-head, swelled as it may be from vascularity, a proper employment of leeches will also often serve instead of a cutting operation upon the membrana tympani.

Scarification of the membrana tympani (Blake), may sometimes be advantageously substituted for incision in cases of vascular and slightly bulging drum-heads.

In performing the operation of incision or paracentesis, I am greatly in favor of what may be called the gentle method.

1. I use a small needle.
2. The incision is made just large enough to give exit to the pus, blood, or mucus.

Important as may be an early, free, and deep incision in paronychia, incisions in the membrana tympani are sometimes too early, because a little delay would render them unnecessary. They are sometimes too free, because they are longer than is necessary to evacuate the fluid contents of the tympanum; and too deep, because they injure the walls of a chamber which it is dangerous to unduly harm. It should be remembered, I think, that the term "a free incision," so cardinal a point in surgery, is, after all, only relative. What would be a free incision in a finger becomes excessively large in a drum-head.



EXPERIMENTAL INVESTIGATIONS AS TO THE  
INFLUENCE OF THE NERVES OF THE DRUM  
CAVITY UPON THE VASCULARIZATION AND SE-  
CRETION OF ITS MUCOUS MEMBRANE.

By E. BERTHOLD, OF KÖNIGSBERG.

Translated by ISIDOR FURST, of New York.

IT is well known that in the innervation of the drum cavity, besides the sensitive fibres of the trigeminus, the sympathetic and the glosso-pharyngeus nerves likewise participate. Not so well known is the physiological importance of these nerves for the middle ear. From an article by Hagen,<sup>1</sup> I first learned that, according to a communication read by Gellé<sup>2</sup> before the Société de Biologie, on December 8th, a distinct vascularization in the mucous membrane of the drum cavity occurs after lesions inflicted upon the medulla oblongata of dogs and rabbits. Hagen, who has tested Gellé's statements, after intercranial divisions of the trigeminus, decides that Gellé's conclusions must be rejected, *i. e.*, that the division of the trigeminus exerts no influence upon the vascularization of the mucous membrane of the drum cavity. On the strength of these contradictory statements by Gellé and Hagen, I thought the question needed renewed investigation, and I undertook the task all the more willingly, because I dared to hope that its answer would at the same time bring nearer to a solution

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<sup>1</sup> Hagen: Ueber das Verhalten der Schleimhaut der Paukenhöhle nach Durchschneidung des Nerv. trigeminus in der Schädelhöhle. *Archiv für experimentelle Pathologie und Pharmacologie*.

<sup>2</sup> Gellé: Lésion de la muqueuse auriculaire à la suite des lésions bulbaires. *Gaz. méd. de Paris*, 1878, No. 1.

the question as to the existence and the quality of the so-called trophic nerves. However, for the purpose of verification, it seemed to me desirable not to restrict the experiments to the trigeminus, but to extend them also to the other two nerves supplying the drum cavity—the sympathetic and the glosso-pharyngeus. Accordingly, the investigation resolved itself into the following series of experiments:

1. Intracranial division of the trigeminus.
2. Semi-lateral division of the medulla oblongata, in order to destroy the roots of the trigeminus.
3. Extirpation of the supreme cervical ganglion of the sympathetic.
4. Tearing out of the glosso-pharyngeal nerve.

Of course, after the death of the animal, every operation was followed by the examination of the mucous membrane and the contents of the bulla ossea of the test animal. The rabbit was the only animal used as such. All the experiments were made in the medico-physical institute of my esteemed friend and colleague, Professor Grünhagen, and the majority with his assistance. We have used considerably more than one hundred rabbits in the investigation. The neurotome which we employed for the intracranial division of the trigeminus was a small knife with a slightly convex edge. The knife itself was adjustable in a sheath. Before the operation, the length of the knife was measured off on a macerated skull which was approximately of the same size as that of the test animal. It could not be projected any farther than the commencement of the sheath, and thus too deep an introduction of the neurotome was avoided. The knife was introduced according to Bernhard's direction. The object of our operation was always the division of the trigeminus immediately in front of Gasser's ganglion, *i. e.*, where the trigeminus emerges from this ganglion. The accidents during the operation I may assume as well known. They cannot always be avoided even by the most expert, because the forms of the skulls of the rabbits employed for the operation often vary greatly. With some practice, constant results are soon secured.

The division was looked upon as successful when the usual symptoms appeared—the screaming of the rabbit as soon as the first branch of the trigeminus was struck; the contraction of the pupil, which again disappears after a while; the anæsthesia of the cornea and conjunctiva of the respective side; finally, the anæsthesia of the Schneiderian membrane and of the upper lip. Even if all these symptoms were developed during life, the animals were still carefully dissected after death, and the three branches of the trigeminus minutely examined both macroscopically and microscopically, from the points of division toward the periphery. Only when a branch could be shown to be degenerated, we considered its division as successful. The division of the first branch was performed only because it gave us the most certain information, by the cry of the animal, whether the knife had been correctly inserted in the act of operation. After some practice in the technique of the operation had been acquired, we spared the first branch of the trigeminus as much as possible, and contented ourselves with scratching it, and causing the animal to scream.

Of the many experiments performed, only those shall be mentioned which justify us in drawing conclusions in regard to the question at issue.

*First experiment, January 21, 1880.*—Gray, medium-sized rabbit. Left intracranial division of the trigeminus. The animal screams loudly. The pupil becomes narrow, the sensibility of the conjunctiva and cornea of the left eye appears slightly reduced. After the withdrawal of the neurotome a profuse hemorrhage ensues. The left eye projects strongly. The nictitating membrane is in almost its full extent drawn over the cornea. After the lapse of half an hour the sensibility of the cornea has completely returned, and seems to be even increased in the lids.

*January 26, 1880.*—The sensibility of the cornea is normal, the globe projects considerably, the nictitating membrane is drawn up. At the lower margin of the cornea is a broad, flat ulcer. The eyelids are sewn together to protect the eye.

On *January 28th*, the condition is the same as on the 26th. When the exposed sympathetic nerves are irritated by the interrupted current, the pupils of both eyes dilate equally distinctly.

The nictitating membrane is withdrawn more slowly from the left eye than from the right, probably on account of the protrusion of the globe, for simple mechanical reasons. The animal is now killed by a stab into the nucha.

The dissection discloses partial division of the ramus ophthalmicus, and complete severance of the other two branches of the trigeminus. In consonance therewith, the microscopical examination of the peripheral termini of the second and third branches shows complete, that of the first, only partial fatty degeneration. In the orbit was found a plexus of greatly dilated veins, which caused the protrusion of the eye. The cavernous sinus is probably compressed during the operation, thus interfering with the return flow from the orbital veins. The left bulla ossea was taken out and the mucous membrane viewed with the ophthalmoscope. It was bright-red, as if covered with a thin layer of coagulated blood. No fluid blood was present in the drum cavity. The mucous membrane of the bulla ossea of the side not operated on was normal.

*Second experiment, January 21, 1880.*—Medium-sized black rabbit. Left intracranial division. No hemorrhage. Complete anæsthesia of the cornea. Contraction, later dilatation, of the pupil. The eyelids were sewn together. The animal is relatively active.

The anæsthesia of the cornea remains constant until the death of the animal, February 2d, A.M. Dissection on the afternoon of the same day. All the three branches of the trigeminus are divided, only a few fibres of the ophthalmicus have been left untouched. The peripheral termini of the second and third branches are completely degenerated; those of the ramus ophthalmicus only partially so. The bulla ossea of the left side is filled with a clear light-yellow fluid, amounting to over 0.1 *ccm.* In order to measure these minute quantities of fluid, a special apparatus had to be employed. Such an one was found in the capillary pipette of the hæmatimeter devised by Hayem and Nachet, used for the counting of the blood corpuscles. When the fluid is sucked up in portions by this instrument, it is easy to determine small amounts quantitatively up to 2 *ccm.* A turbid substance was suspended in this yellow fluid. The microscopical examination of the liquid shows sparse, globularly expanded vibratile cells, and coarsely granulated cells, which probably were only more fully altered vibratile cells. They floated mostly aggregated into balls in the field of the microscope.

*Third experiment, January 27, 1880.*—A medium-sized gray rabbit is operated upon. The anæsthesia of the cornea on the operated left side subsides quickly. The cornea remains transparent.

*Fourth experiment.*—The same rabbit is operated upon on the right side, on January 30th. Anæsthesia of the cornea is complete. Suture through the margins of the lids; nevertheless, the cornea becomes opacified. The animal dies on the morning of February 3d. Dissection on the afternoon of the following day. On the left side the ramus ophthalmicus was only cut into, but the other two branches were completely severed. The microscopical examination, therefore, exhibited only fatty degeneration of a small number of fibres of the first branch, but complete fatty degeneration of the other two branches. On the right side all the three branches are completely severed, the ramus ophthalmicus so close to the ganglion of Gasser that some ganglion cells are still to be seen on the peripheral end of the first branch. Accordingly, the fatty degeneration of the first branch is only partial. The other two branches are completely degenerated, although but three and a half days have elapsed from the second operation to the death of the animal.

The examination of the two bullæ is made by Grünhagen alone. The left bulla is filled with a fluid in which no fibrin is precipitated. The fluid in the right bulla, however, contains threads of fibrin.

*Fifth experiment, January 21, 1880.*—Left intracranial division. The anæsthesia of the cornea lasts but one hour.

*Sixth experiment, January 27, 1880.*—Right division by Grünhagen on the same animal. After the withdrawal of the neurotome, slight arterial hemorrhage. The animal is firmly placed near a moderately warm stove so that it can perform no rolling motion. The cornea of the right eye is quite insensible. Both eyes project somewhat; the nictitating membrane is drawn before both eyes. The palpebral fissure of the right eye is closed by a suture; the cornea in the next few days is still opaque and infiltrated. Death on the morning of February 4th. Dissection on the afternoon of the same day. On the left side the first branch is only cut into, the second branch is completely, and the third incompletely divided. The eye is clear, the drum cavity free from fluid. On the right side all the three branches are found severed, cornea opaque, drum cavity likewise empty.

*Seventh experiment, Jan. 23, 1880.*—Left division. The cornea soon after the operation is again sensitive.

*Eighth experiment, Jan. 30, 1880.*—Right division. Anæsthesia of the cornea, of the nasal mucous membrane, of the facial bristles. The jaw is drawn toward the left side. Death on Feb. 4th, 10 A.M., dissection on the evening of the same day. Left side : first branch uninjured, second and third branches divided, bulla empty. Right side : first and second branches divided, third branch not severed. Nevertheless, a blackish-red bloody coagulum is found in the drum cavity.

*Ninth experiment, Jan. 27, 1880.*—A white rabbit is operated by Grünhagen upon the left side. The cornea remains sensitive ; the animal is lively.

*Tenth experiment, Jan. 30, 1880.*—The right division is executed on the same animal by myself. The cornea has remained sensitive. Death on Feb. 6th, P.M. Left side : first and second branches normal, third branch degenerated. Right side : the first branch is but partially degenerated, the second not at all, the third completely degenerated. Both bullæ contain no fluid.

*Eleventh experiment, Jan. 26, 1880.*—Left division. Cornea anæsthetized, becomes opaque soon after the operation, and clears gradually. Death, Feb. 6th, A.M. First branch partly, second and third branches completely degenerated. Bulla empty.

*Twelfth experiment, Feb. 11, 1880.*—Left division. The sensibility returns one hour after the operation. Death on Feb. 18th, P.M. Dissection one hour later. First branch of the trigeminus only cut into, second and third branches completely divided and degenerated. The bulla ossea is broken on removal, by carelessness with the needle scissors. It is filled with coagulated blood. The bulla on the uninjured right side is normal.

*Thirteenth experiment, Feb. 11, 1880.*—Left division. Anæsthesia of the cornea and of the nasal mucous membrane. The cornea is purulent. Death during the night between February 22d and 23d. Dissection on the afternoon of February 23d. All the three branches are completely severed and degenerated. Left bulla completely filled with pus. Mucosa thickened and discolored. Right bulla normal.

*Fourteenth experiment, Feb. 11, 1880.*—Intracranial left division of the trigeminus with the desired result. Anæsthesia of the cornea, etc. Killed on Feb. 23d, P.M., with chloroform. Dissection immediately afterward. The cornea shows an opaque cen-



tral infiltration. Complete severance and degeneration of the three branches. Upon the right side of the brain was found a coagulum of blood at the convexity. Left bulla full of pus, right bulla normal.

*Fifteenth experiment, Feb. 16, 1880.*—Left intracranial division of the trigeminus with the desired result. Death on Feb. 23d, by chloroform. Dissection immediately afterward. All three branches completely severed and degenerated. The bulla of the left side contains a slight red secretion and a great number of little air-bubbles (foamy secretion). The bulla of the right side is normal.

*Sixteenth experiment, Feb. 16, 1880.*—Left intracranial division of the trigeminus. The sensibility of the cornea soon returns.

*Seventeenth experiment, Feb. 24, 1880.*—On the same rabbit the right-sided division of the trigeminus is performed. Death on March 1st, A.M. Dissection on the afternoon of the same day. Left side: first branch partly, second and third branches completely severed and degenerated. The bulla quite filled with white, thick pus. Right: all three branches incompletely degenerated. Cornea totally purulent. Bulla one third full of bloody, semi-solid contents.

*Eighteenth experiment, Feb. 24, 1880.*—Left intracranial division of the trigeminus. Anæsthesia, later ulceration of the cornea. Death on March 5th by chloroform, dissection immediately afterward. First branch of the trigeminus partly, second and third branches completely degenerated. The left bulla filled with rather thick pus which adheres firmly to the walls and does not flow out. Right bulla normal. Mucosa of the left bulla thickened, gray, discolored.

*Nineteenth experiment, Feb. 24, 1880.*—Intracranial division of the trigeminus on the left side. The sensibility of the cornea returns after twenty-four hours. Death on March 5th, by chloroform. Second and third branches completely degenerated, first branch but little injured. Left bulla filled with a purulent fluid. Mucosa of the bulla gray, discolored, thickened.

One of these nineteen cases must be left out of the calculation. In it a small black blood-coagulum was found in the bulla, although the third branch of the trigeminus had been missed; probably this coagulum has an origin which stands in no relation to our question. Of the remaining 18 cases,

in 6 no exudation, and in 12 a partly serous, partly bloody, partly purulent exudation was found in the bulla; and in the latter 8 cases, in which the intended section always extended in the same manner, the result was likewise almost exactly equal, the bulla of the respective side being uniformly filled with exudation, mostly thick pus.

Turning now to the *second* series of experiments, in which the roots of the trigeminus were severed in the medulla oblongata, the contraction of the pupil of the eye on the respective side was again looked upon as the sign that the operation had succeeded. Nevertheless, after the death of the test animal, a careful examination of the severed portion was made each time. A chisel-shaped knife devised by Grünhagen was employed as neurotome, which was adjustable with another pointed double-edged knife in such a manner that the surfaces of both blades together formed a right angle. After exposing the posterior obturator membrane, the pointed knife was inserted down to the bone, close to the exterior margin of the medulla oblongata, parallel to the raphe. On protruding the chisel-shaped knife, the width of which was exactly that of one half of the medulla oblongata, one half of the latter was completely severed. After the operation, the animal generally lay apathetically on the affected side. A large number of the animals died soon after the operation, usually in consequence of a considerable hemorrhage, and thus could contribute nothing to the solution of the problem. Whenever the animals survived the operation at least twenty-four hours, the bulla ossea was removed and examined. On considering the results collectively as before, we find that in nearly all cases (nine times in ten) an alteration occurred in the mucous membrane of the bulla on the operated side. In two cases could be found only a greater injection, or a general moistening of the mucosa, but in the remaining seven cases a quantity—even if small—of serous or sanguineous fluid, which in one case amounted to 25 *ccm.* Particularly notable, however, was the condition of the bulla on the sound side. For in three fifths of all cases the same alteration was present on the sound side as on the one oper-

ated on, although in a minor degree. We are thus forced to assume for these cases a sympathetic affection.

In the *third* series of experiments, in which the upper cervical ganglion of the sympathetic was extirpated, we found in four consecutive cases the same result—that the bulla ossea on both sides had remained normal and unchanged. I only mention casually, as self-evident, that the well-known symptoms were connected with the above-mentioned extirpation—persistent injection of the vessels of the ear of the rabbit, together with contraction of the pupil.

In like manner the *fourth* series of experiments, in which the glosso-pharyngeus nerve was torn out as far as the lowest ganglion of this nerve (comp. Krause: "Die Anatomie des Kaninchens," p. 240), taught us that this operation was unable to exert any influence upon the condition of the mucous membrane of the bulla ossea. In the four operations performed by us, we invariably found the lining of the bulla ossea unchanged. From these experiments it appears to be certain that injuries to the sympathetic and glosso-pharyngeal nerves exert no visible influence upon the mucous membrane of the drum cavity of the rabbit; however, that injuries to the trigeminus, both at its roots in the medulla oblongata and in the cranial cavity in front of Gasser's ganglion, that is, where the trigeminus emerges from this ganglion, produce inflammatory alterations in the mucous membrane of the drum cavity, which may represent all stages of inflammation, from simple vascularization to purulent exudation.

Important though this positive result be, we still had to admit that we had solved but one half of our task. Of the disturbances of innervation in the region of the middle-ear nerves, we had examined only that part which was incited by *paralysis* of the respective nerves. There remained to us to study the intratympanic alterations after *irritation* of the before-mentioned nerves. We could not gain time for the execution of this SECOND PART of our task until during the winter course of 1880–1881, after I had reported the first part at the meeting of naturalists and physicians at Danzig (comp. the *Journal*, p. 257).

The experiments to ascertain the influence of irritation of the sympathetic, trigeminal, and glosso-pharyngeus nerves upon the mucous membrane of the drum cavity, or, to speak more exactly, upon the condition of the vessels extending within it, were made exclusively on cats, because we soon became convinced that the rabbit, which had served as test animal for the first part of our experiments, was unsuited to those we contemplated. The vessels of the mucous membrane of the drum cavity in the rabbit are too small to permit the recognition of distinctly visible alterations in their calibre, even under the greatest possible magnifying power. On the other hand, these vessels in the cat, especially when viewed with the magnifying glass, presented an exceedingly handsome aspect.

The chloroformed cat having been fastened to an operating board in the dorsal position, the head is fixed so as to make the vertex region touch the board, by means of a string attached to a strong wire-bit inserted into the mouth of the animal. Then an incision into the skin is made in the medial line of the neck, below the thyroid cartilage, and from three to four centimetres in length. On displacing the skin to the right and left, the trachea is seen to gleam through from below; not far from it on both sides is the carotid artery, and, in a lateral direction from the latter, the vago-sympathetic nerve. Still more laterally, and quite superficial, is the external jugular vein, which can be easily isolated. The trachea having been exposed, and a couple of rings having been opened, a glass canula is inserted into it. The other end of the glass canula is connected with a pair of bellows by means of a rubber tube, for the purpose of artificial respiration. Then enough curare is carefully introduced into the external jugular vein by a Pravaz's syringe to induce the first spasms due to asphyxia in the animal.

The vein having been ligated, artificial respiration commenced, and the animal freed from its bonds, the intended experiment can be started. Prussak,<sup>1</sup> under Ludwig's direc-

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<sup>1</sup>Dr. A. Prussak: *Zur Physiologie und Anatomie des Blutstromes in der Trommelhöhle. Bericht über die Verhandlungen der Königl. sächs. Gesellschaft der Wissenschaften zu Leipzig. Mathem. physical. Klasse, Bd. xx, 1863, p. 201.*

tion, having already tested the effects of irritation of the sympathetic on the condition of the vessels in the drum cavity of the dog, it appeared to us advisable to commence this second part of our work with the repetition of Prussak's experiments. We therefore exposed the right bulla ossea of a cat, carefully broke off small pieces of its osseous shell with needle forceps, until we had secured an opening of about one centimetre diameter; then we cut into the hitherto uninjured mucous membrane of the bulla, which adheres to the bone very loosely, and folded the flaps of mucosa back upon the margin of the bone. In this manner we had exposed the field for the observation. Nothing remained now but the adjustment of the illuminating apparatus and of the magnifying glass for the inspection of the vessels of the bulla. For the illumination we employed an apparatus ordinarily used for rhinoscopic examinations, the light-rays of which issue in a parallel direction. These light-rays were caught upon an otoscopic mirror and thrown upon the object of the examination. Between the latter and the mirror was inserted the bull's-eye condenser of a Hartnack microscope, fastened on a stand, but adjustable, to serve as a loupe. The whole apparatus, therefore, was absolutely firm, only the mirror was held in the hand; but even here an almost unchangeable position of the mirror was secured by resting the hand on the operating table. This precaution, however, was positively essential, as otherwise faulty illumination might have been caused. Another requisite for the undisturbed course of the experiment is the manner of the nervous irritation. It is not permissible to lift the exposed sympathetic out of the wound for each separate test, and to lay it upon the afferent electrodes of the induction coil, but it is to be recommended that it be placed in continuous contact with the wires leading the current, by means of Ludwig's<sup>1</sup> electrodes.

As regards the anatomy of the vessels in the drum cavity, they belong to the internal carotid and the tympanic branch of the internal maxillary artery. The arteries in the bulla,

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<sup>1</sup> See their description in "*Arbeit. d. physiol. Arch. zu Leipzig*," Jahrg. 1875, p. 234, and E. Cyon, *Atlas z. Methode d. physiol. Experim.*, plate iv, fig. 3, A and B.



however, are so small that they, as already pointed out by Prussak, are barely recognizable even when magnified with the glass, so that we are chiefly confined to the observation of the veins. Like Prussak, we also have found it advantageous to observe the vessels continuously before, during, and after the irritation of the nerves; for "the experiment is a very delicate one." According to Prussak, at the beginning of the irritation of the sympathetic, the vessels dilate slightly at first, then they become paler, and remain in that condition as long as the irritation continues. After the termination of the experiment, the vessels become especially distinct. We can confirm Prussak's experiments in every particular, with perhaps the single qualification that the initial dilatation of the vessels, after the irritation, was not distinctly visible. We fully concur, however, with Prussak's statement that the experiment conducted in this manner is a very delicate one. We therefore decided to modify the experiment somewhat, and thus obtained quite certain, indubitable results. The modification of the experiment consisted, in the main, in leaving the bulla uninjured and obtaining an insight into the drum cavity from the meatus, after partial removal of the membrana tympani. In connection therewith, we dissected the cochlea, as far as the osseous auditory meatus, from the animal's skull, and, every hemorrhage having been carefully arrested, twisted the cochlea away from the skull at the osseous auditory meatus, during which operation barely a drop of blood escaped. Now the membrana tympani was fully exposed, as the osseous ear-canal is but a few millimetres in length. The vessels of the manubrium mallei of the drum being visible even to the unaided eye, we thought it opportune to first test the influence of irritation of the sympathetic upon the condition of these vessels, and afterward to make a hole in the membrana tympani to permit inspection of the drum cavity.

It is well known that the vessels of the membrana tympani originate from the cuticular vessels of the auditory meatus (from the arteria auricularis profunda and the arteria auricularis posterior). A few larger vessels stretch from the upper wall of the ear-canal transversely across the upper



section of the drum, and then immediately extend over the manubrium mallei as far as the umbo. The manubrium in the cat also extends from above anteriorly to below posteriorly, deviating slightly from the vertical direction; it is surrounded by a thin, translucent strip of cartilage. The appearance of the manubrium, with the two parallel vessels coursing upon it and the bilaterally visible, almost transparent strip of cartilage, is exceedingly handsome. As the two vessels contract gradually toward the umbo, their inferior extremity is barely recognizable even under the glass, while their upper part can be easily seen with the unaided eye. It is just this condition of the manubrial vessels which renders them particularly appropriate for our observation; for as they fill, the red thread of blood within them appears to lengthen, to cross at the umbo, and there form a loop. But if they contract, the ends at the umbo disappear first; then the paling proceeds upward, until finally the entire manubrium appears white. *On this object we tested the influence of irritation of the cervical sympathetic, and could convince ourselves to our perfect satisfaction that on irritation the vessels contract until they become invisible; that after the cessation of the irritation they refill and become even thicker than before the experiment commenced.* The duration of the irritation until the vessels disappeared lasted from five to ten seconds, and until their complete refilling after the cessation of the current, thirty to fifty seconds. In general, the lapse of time until the disappearance of the vessels coincided pretty closely with that until the greatest dilatation of the pupil; and the time until the refilling of the vessels, with that until the beginning of the complete contraction of the pupil. Repeated experiments having convinced us of the prompt effect of irritation upon the contraction of the vessels of the membrana tympani, we severed the posterior segment of the drum from the tympanic ring by means of a blunt needle. This operation usually succeeds without the loss of a drop of blood. The mucous membrane thus exposed looks very pale at first, but gradually it reddens slightly, probably in consequence of the irritation caused by the influx of atmospheric air. If the sympha-

thetic was then excited, we could observe with certainty a narrowing and paling also of the vessels of the tympanic mucous membrane; although not with the distinctness of the manubrial vessels, yet with far greater clearness than in previous experiments in which the bulla ossea was broken open, according to Prussak's procedure.

It is, therefore, proven, that *the sympathetic must be considered to be a vaso-motor nerve for the ear*. Although we have furnished the demonstration only for the external and middle ear, yet we cannot exclude the labyrinth, because we know that a part of the vessels of the drum cavity reach the labyrinth both by way of the fenestra rotunda and ovalis (Buck) and through the bony walls (Politzer).

In a *second* series of experiments we then tested the influence of irritation of the trigeminus upon the condition of the vessels of the middle ear.

The first experiment we conducted in such a manner that two needles at a slight distance from each other were introduced into the medulla oblongata of a curarized cat. The needles were connected by thumb-screws with the wires of an induction apparatus. Whenever we irritated the medulla oblongata in this manner, we could observe the paling of the vessels of the drum more speedily than in the preceding experiments. But as the centres of the most various nerves are situated in the medulla oblongata, no positive conclusion could be drawn from this experiment for the present; but, basing on the experience that irritation of the cervical sympathetic as well as irritation of the medulla oblongata produces contraction of the vessels of the membrana tympani, we might well venture the conjecture that the fibres of the sympathetic extending into the medulla oblongata may be the cause of the observed phenomena. In the same cat, therefore, the cervical sympathetic and the vagus were severed on both sides. The inhibitory action of the vagus on the heart we could not assume to be of much account in the curarized animal, for its division could only increase the positiveness of the experiment. Our conjecture was completely confirmed, for now, after irritation of the medulla oblongata, instead of the previously observed

contraction, we obtained an evident dilatation of the vessels of the membrana tympani. How should this vascular dilatation be interpreted? Could we refer it to an irritation of the root of the trigeminus? The well-known fact that irritation of the splanchnicus, the vaso-motor nerve of the abdomen, considerably increases the blood-pressure in the aorta by the contraction of all the terminal branches, led us to the conjecture that the vascular dilatation observed by us in the manubrial vessels after irritation of the medulla oblongata, at least to a considerable extent, should be referred to a purely mechanical filling of these vessels, inasmuch as the splanchnicus is excited conjointly with the medulla oblongata. In order to exclude from the irritation not only the splanchnicus, but all vascular nerves, which, as is well known, have their centres to a great extent in the medulla oblongata, we determined to sever the spinal cord close to the medulla oblongata in the next experiment. Unfortunately the cat on which this operation was performed lost so much blood that the experiment could not be looked upon as convincing. In like manner the succeeding experiments in which the spinal cord was divided did not turn out to our satisfaction. Several of them miscarried without any fault of ours, cats with diseased ears being repeatedly encountered. Usually the meatus was plugged with masses of cerumen, the membrana tympani thickened, opaque, at times also perforated, and exudation in the drum cavity. We were, therefore, unable to make any observation of the tympanic vessels, and on inspecting the vessels of the drum cavity we could see neither their contraction nor dilatation on irritating the medulla oblongata isolated in the manner above-described. In order to furnish proof positive that increased pressure in the carotid was followed by visible filling of the tympanic vessels, we instituted the following experiment: The thorax of a curarized cat was opened so as to gain access to the thoracic aorta after opening the sixth or seventh intercostal space. If then the aorta was compressed with the fingers or some appropriate contrivance, and the manubrial vessels were observed both during the compression and after its cessation,

we found that an alternate dilatation and contraction of the vessels actually occurred. In this way we had furnished positive demonstration that irritation of the medulla oblongata, without division of the spinal cord or the splanchnicus, by a simple simultaneous irritation of the abdominal vasomotor nerves, had given rise to increased filling of the tympanic vessels, and that, therefore, the dilatation of the vessels must be interpreted as a simple mechanical replenishment. Hence we are forced to the assumption that the trigeminus and the glosso-pharyngeus nerves—which are also implicated in the irritation of the medulla oblongata—have no visible influence on the condition of the observed vessels. As the glosso-pharyngeus anastomoses with the trigeminus (as well as with the facial, vagus, and the carotid plexus of the sympathetic) by branches which extend into or from the petrous ganglion, an isolated irritation of either of those nerves was not to be thought of.

Finally, *to summarize the results obtained by our investigations*, we have found, first, that lesions of the trigeminus, both at its trunk and its roots, provoke inflammatory symptoms in the middle ear; but there are differences in the sequels, according to the location of the lesion. The greater intensity of the inflammatory affection occurring after intracranial division may be explained by the prolonged duration of the inflammation. After semilateral division of the medulla oblongata the animals die too quickly to permit the inflammation to reach its height. Still more noteworthy than the difference in the intensity of the phenomena, is the condition of the bulla of the uninjured side. Differing in this respect from intracranial division, we found as a result of semilateral division of the medulla oblongata almost invariably some secretion in the bulla of the sound side. Inclined though we were at first to regard this disturbance in the lining membrane of the middle ear as a sympathetic one, we still found no reason for the fact that such a sympathetic inflammation never occurred after injury to the trunk of the trigeminus, and we must leave it an open question whether perhaps a crossing of fibres takes place in the medulla, and a part of the trigeminus-fibres

extends to the middle ear of the other side. The acceptance of the latter assumption would make it self-evident that a lesion confined to one half of the medulla oblongata would affect both ears in the same manner, although in varying degree.

The investigations taught us, moreover, that the sympathetic must be regarded as a vaso-motor, and, according to the extent of our experiments, as an exclusively vaso-constrictor nerve of the entire ear, because a distinct narrowing of the auricular vessels was always observed after irritation of the sympathetic. On the other hand, we obtained negative results respecting the state of the vessels after irritation of the trigeminus as well as after injuries to the sympathetic, trigeminus, and glosso-pharyngeus. Prussak has already called attention to the fact that the constrictor action of the sympathetic, after its irritation, should lead us to suppose a dilatation of the vessels of the ear after paralysis of this nerve; the more so, as we know that division of the sympathetic is followed by filling of the arteries in other parts of the head. However, we fully concur with Prussak that the experiments have not borne out this supposition. Contrary to our expectation, the mucous membrane of the middle ear remained invariably pale, even when the division of the sympathetic had preceded the examination of the drum cavity by several days.

The most surprising result of our investigations, however, was the negative state of the middle-ear vessels both after irritation and after paralysis of the trigeminus, for soon after division of this nerve neither dilatation nor contraction of the middle-ear vessels could be observed. Nor could we, as stated before, observe any visible alteration in the fulness of the vessels by irritating this nerve. Although we could ascribe to the trigeminus neither vaso-constrictor nor vaso-dilator qualities, while division of its trunk or injury to its roots was regularly followed by inflammatory phenomena in the middle ear, it appeared reasonable to acknowledge, in this case, the influence of the neurotomy as a merely trophic one, that is to say, to refer it to the existence of special trophic nerves. If we compare the

process in the drum cavity with the so-called trophic keratitis, the phenomena in the drum cavity—protected as it is from injurious atmospheric influences—permit our drawing a more unambiguous conclusion in regard to the existence of these nerves—hitherto always considered doubtful—than the consequences of division of the trigeminus in the eye, which certainly permit of several interpretations. A traumatic otitis after division of the trigeminus could not be thought of, for the reasons stated.

To what extent practical experience may be harmonized with the results of our investigations must be the subject of a separate article.

KÖNIGSBERG, *April*, 1881.



## THE INHALATION OF CHLOROFORM A CAUSE OF AURAL DISEASE.

BY CHARLES E. HACKLEY, M.D., OF NEW YORK.

WITH a view of calling attention to a matter that I have never seen mentioned in medical literature I would refer to a case lately seen.

A lady aged 40 years consulted me about her hearing; she said that some eighteen years previously while hearing well, and, so far as she knew, with no disease of the ears or throat, she inhaled chloroform to complete narcosis for a surgical operation; on awaking from the sleep induced, her hearing was much impaired, and had remained about the same ever since; at no time was there tinnitus or pain. At a short distance she hears a distinct voice quite well, but cannot distinguish general conversation. Has had no treatment, and has not grown better or worse. The throat and membranæ tympani look normal, the Eustachian tube is pervious, and it would seem as if the amblyakousis (?) were due to some nerve derangement, probably of vascular origin.

This case alone would not be worth calling attention to, but it brought to my recollection two others which occurred in patients seen at the N. Y. Eye and Ear Infirmary. One of these I merely remember as being quite hard of hearing, as he claimed from inhalation of chloroform. The other was a man of middle age, who said he heard well until he took chloroform to have an iridectomy performed; at the time I saw him he was entirely deaf, and he said the deafness came on during the narcosis. I have not the notes of these cases, and at the time doubted their accuracy. In the last

case, for instance, the iridectomy might have been called for by the results of a syphilitic iritis, and the syphilitic poison might have induced the deafness. In the rush of a large dispensary class, a full record of a case, possibly a coincidence, was neglected.

But a third case of a similar accusation against chloroform, has induced the present note. Anæsthesia by chloroform being rather unusual here, the opportunity of examining membranæ tympani of patients under its influence has not lately occurred to me.

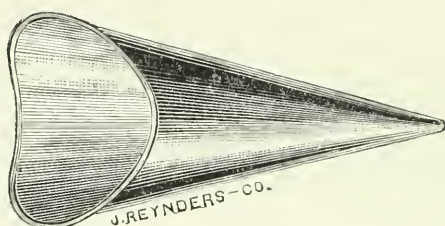
[Several cases of tinnitus aurium and loss of hearing have come under my observation, which were said to have been caused by the inhalation of sulphuric ether for the purposes of anæsthesia. It has, as yet, been impossible for me to decide as to whether or not anæsthesia by chloroform or ether does sometimes cause permanent congestion of the ear. The membrana tympani is sometimes found to be congested during the inhalation of ether.—D. B. ST. J. R.]

## THREE AUKAL CONVENIENCES.

BY F. M. WILSON, M.D., OF BRIDGEPORT, CT.

### 1. *An ear-basin.*

Cone-shaped, as seen by cut below ; made of sheet metal, japanned or nickel-plated. Its supposed advantages are : its greater capacity ; less liability to slop, a cone-shaped dish requiring much more motion to spill its contents than one of the usual shallow form ; the greater ease with which it is

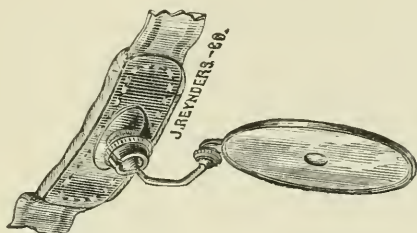


held in position ; and, lastly, being cut away in front, it is less in the way of the syringe. The cone is sixteen inches long, and seven inches in diameter at its widest part. The head is turned slightly to the opposite side, and the cone is steadied against the front of the shoulder when in use.

### 2. *An attachment for holding forehead-mirrors.*

As will be seen by cut, there are two ball-and-socket joints instead of one, and the one on the mirror is in front instead of behind it. Each joint can be loosened or tightened at will by rotation of the socket. There is greater freedom of

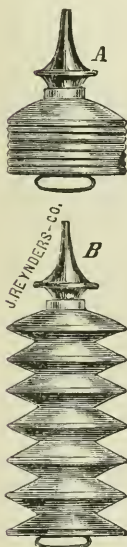
motion than could be obtained in any way with only one joint; and one motion, which is new, viz., movement of the whole mirror directly backward, so that it can be ad-



justed as close to the eye as a hand-mirror of the same size.

This is important, of course, only for those who look through the aperture.<sup>1</sup>

### 3. *An inflation apparatus and ear-syringe combined.*



It consists of a hollow cylinder having stiff, hard rubber ends and flexible rubber sides. The sides are made to fold and open like those of a Chinese paper lantern, but are made stiff enough to prevent any displacement of their folds by the pressure of air or water. To one end is attached a flexible rubber loop for the thumb, into the other is screwed the nozzle, with a projection on it so that the fingers can grasp it and the apparatus be worked with one hand. The diameter of the end of the cylinder is about two and three-fourth inches, and its two ends can be separated from each other three to four inches. It is especially useful for work outside of the office on account of its portability.

<sup>1</sup> John Reynders & Co., makers.

## A CASE OF EPITHELIOMA OF THE MIDDLE EAR.\*

BY CHARLES J. KIPP, M.D., NEWARK, N. J.

H. K., a very large and fleshy German woman, 50 years of age, applied to me for relief from a very severe pain in her right ear and head, in June, 1880. From her statement it appears that she has suffered from an offensive otorrhœa from right ear since birth, and that until a year ago she never had an earache. About three months ago a fleshy mass made its appearance in the external meatus, and has since then gradually increased in size. For the last month she has suffered intensely from pain in ear and head. About three days ago she first noticed that she could not close the lids of the right eye, and that the whole right side of the face was paralyzed.

On examination, the right auricle was found to be entirely normal. The external meatus was completely filled by a red, spongy, lobulated mass, which protruded somewhat beyond the plane of the meatus. Examination with the probe showed the mass to sprout from all sides of the external canal. In appearance the mass was not unlike a so-called "raspberry" polypus. The mastoid process was swollen, and its lower half of a dark-red color. This swelling was soft, but no fluctuation could be detected. The part immediately in front of the tragus was also considerably swelled, but its integument was of normal color. No pus could be detected. Although so much swelled, the parts around the auricle were not very sensitive to the touch. The right half of the face was paralyzed. The ear was deaf to every sound. The examination of the eyes with the ophthalmoscope revealed a perfectly healthy condition of these organs.

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\* Read before the American Otological Society at Newport, R. I., July 26, 1881.

Although pretty confident, from the peculiar character of the growth in the external meatus, that I was dealing with a malignant disease, I concluded to remove as much as possible of the fungoid mass for the purpose of giving vent to the pus which I supposed was pent up by the obstruction, and caused, in part at least, the great pain from which the woman was suffering. With the aid of the snare and scissors I succeeded in clearing the greater part of the external canal, and thereby gave exit to a quantity of extremely offensive, sanious pus. The middle ear was found to be filled with similar masses, which were, however, left untouched. Examination with a probe showed the walls of the external canal to be carious. The patient was ordered to syringe the ear with warm water, and the sulphate of morphia was given in large doses to relieve the pain. Although requested to present herself again on the following day, she did not return till ten days later, saying that the intense pain in head and ear had compelled her to stay in bed for a week. The external meatus was again completely filled by a fungoid mass, and on the lower half of the mastoid process there was now a soft, oblong, circumscribed elevation of livid color, about 3 *cm.* in length, which gave an indistinct sense of fluctuation. The integument of the part in front of the ear was now also of a deep-red color and more swollen, but no fluctuation could be made out here. The pain was excruciating. Hoping to give exit to pus, I made an incision into the swelling over the mastoid, but no fluid, except a few drops of dark blood, was evacuated. The swelling was filled by a fungoid mass. There being no longer any doubt as to the malignant character of the disease, I abstained from further surgical treatment, and ordered the fungoid masses to be dusted over twice daily with a powder composed of arsenious acid and hydrochlorate of morphia each 0.25 parts, calomel 2 parts, and powdered gum Arabic 12 parts,—a formula strongly recommended for cases of open cancer by a German surgeon whose name I cannot now recall. At the same time I gave sulphate of morphia internally, as before. For a while the growth of the fungoid masses appeared retarded by the powder, but within a month new masses broke through the skin over other parts of the mastoid, and also in front of the tragus. The patient was now scarcely able to separate the jaws on account of the swelling in front of the ear, and suffered also from great difficulty in swallowing, caused by the formation of a swelling on the right side of the pharynx. None but liquid food



could be taken, and only little of that. The fungoid masses in front and back of the ear continued to grow, and others made their appearance beneath the auricle, so that at last it remained attached only to the parts above. The stench from these ulcerating surfaces made it almost impossible to remain in the patient's room, although disinfectants were freely used. No swelling of the submaxillary glands or the glands of the neck could be felt. During the last week of her life she had numerous convulsions, which were followed by coma. She died about six months after I first saw her. No autopsy could be obtained.

The microscopic examination of the fungoid masses removed from the external canal showed that they were composed of large epithelial cells, with large and distinct nuclei, arranged in cylinders, which contained also many pearly globules. The cylinders were held together by scant connective tissue. The outline of many of the cells was serrated.

The above case derives its interest chiefly from its rarity. Besides the few cases collected by Schwartz (Archiv f. Ohrenheilkunde, Bd. ix, p. 216), I have been able to find but two others, one described by Lucae (Archiv f. Ohrenheilkunde, Bd. xiv, p. 127), and the other by Delstanche (Son) (Archiv f. Ohrenheilkunde, Bd. xv, p. 21). In the last-named case the disease started probably in the external canal.

Whether this was also the case with my patient it is, of course, impossible to say. Taking, however, into consideration the fact that the pain preceded the appearance of the growth in the external canal by some nine months, I am inclined to the belief that it originated in the deeper parts of the ear.

As regards the symptoms and the course of the disease, this case does not differ materially from those previously recorded. The chronic otorrhœa was, however, a feature which was present in but few of the reported cases. Whether this long-continued otorrhœa favored or caused the development of the cancer must remain in doubt. But in view of the well-established fact that cancer is not rarely developed in other parts of the body which are the seat of chronic inflammatory changes, it seems at least not improbable that the constant local irritation present in the in-

flamed textures of ears affected with caries, may cause the development of malignant disease (Roosa, Schwartze).

Although the peculiar attachment of the tumor to the walls of the external auditory canal, aroused suspicion as to its character on the patient's first visit, the case, when first seen, was so much like many cases of chronic purulent inflammation of the middle ear, with caries of the temporal bone, that the true nature of the affection was determined only by the microscopic examination of the fragments of the growth removed at the first visit.

## THE CLINICAL DIAGNOSIS OF ACOUSTIC NEURITIS AND OF ATROPHY OF THE ACOUSTIC NERVE.

By D. B. ST. JOHN ROOSA, M.D.

A SUFFICIENT number of *post-mortem* examinations of ears whose history was well known by the means of careful examinations during the progress of affections of which they were either the sole seat, or in which they were involved, has long been considered to be the great want in the diagnosis of aural disease. This want has been quite fully met in the case of certain troubles in the middle ear, although much remains to be done in the case of chronic non-suppurative cases, of which patients seldom or never die. In the diseases of the internal ear we are of late also making progress. Such investigations as those of Moos and Steinbrügge, are constructing a pathology of the labyrinth and acoustic-nerve trunk, so that we may soon be able—even without that seemingly impossible desideratum, a sight of the central organ of hearing in life—to make an exact diagnosis of its affections. As a clinical observer, I am coming more and more to the conviction that we are able even now, in some cases, to determine the existence of acoustic neuritis and of acoustic atrophy. I will present in this paper a few cases in which the diagnosis may, I think, be made, and I shall endeavor to give the grounds upon which my conclusions have been formed.

CASE I.—I. P. H., æt. 59, farmer. Sent by Dr. G. W. Holmes, April 26, 1880. The patient thinks he has been growing hard of

hearing for a year. The son (Dr. H.) believes that this period could be extended back to three or four years. He has some tinnitus, but this symptom does not seem to be a marked one. His ears have never received any treatment. He hears the watch R  $\frac{c}{48}$ , L  $\frac{c}{48}$ ; my voice, in a room 50 feet long, 25 feet. The aërial conduction is said by him to be twice as loud as that through the bones. He has large auditory canals. Both membranæ tympani are depressed. The light spots are fully formed. There are opacities at the margin. Common air and vapor of chloroform, used by my attachment to Politzer's bag, redden the drum-heads, but the patient does not feel them enter the drum, nor does the hearing improve after the ears are inflated.

*Remarks.*—The points in favor of a diagnosis of disease of some part of the labyrinth or acoustic nerve in this case, to my mind, are:

1. The lessened conduction by bone.
2. The fact that although his ears have never before been inflated, no improvement results from forcing air into the tympana.
3. The entrance of the vapor of chloroform into the middle ear is not felt by the patient.

Only one of these points needs any comment, for two of them are pretty well recognized as giving color to the diagnosis of disease of the labyrinth.

Dr. Ely thinks, from some extended observations on this point, that in certain cases of affections of the acoustic nerve the patient fails to perceive the entrance of vapors into the middle ear, when we can be tolerably sure that air has really entered, and that this, in connection with other symptoms, makes a diagnostic point.

This clinical fact I am inclined to believe to be a substantial one, but I leave a discussion of it to my colleague at some other time.

Those who are inclined to make a diagnosis of disease of the middle ear from the appearance of the membrana tympani alone, will perhaps make one in this case, but I lay very little stress upon this appearance by itself. So long as there is a good light spot, I think even a partially sunken membrana tympani will do its work very well. Besides that,

there are cases of changes in the membrana tympani that are evidently secondary to disease of the central apparatus. Again, in childhood or youth, passing affections of the tympanic cavity leave changes upon the drum-head. They may be considered as analogous to certain opacities of the cornea.

The insidious approach of the loss of hearing in this case, the absence of nasal and pharyngeal symptoms, all incline me to believe, although I admit the evidence is slight, that atrophic changes have taken place in the acoustic nerve. If, however, I only had such cases as these to rely upon, that is, cases in which the history was no more full, I should simply make the diagnosis, as this one is, in fact, entered on my case-book, of disease of the labyrinth.

CASE 2.—Mr. S., æt. 46, sent by Dr. E. Dupuy, October 20, 1880. This patient is a large, well-developed man of great intellectual activity, who is engaged in great enterprises in the Western States. He leads a very irregular life, eats very rapidly and very much, takes long journeys very often, but he is not intemperate in the use of alcohol or tobacco. He began to have attacks of vertigo and nausea five years ago, so that he would be obliged to lie down for hours. He had to lie on his back; could not turn on his side or his belly. He thinks he observed tinnitus and impairment of hearing after the first attack. Ever since his hearing power has been variable. *He hears worse in a noise; low tones are heard best; music is disagreeable.* He has no pain in his ears; the attacks of vertigo are growing less frequent. Has a sense of general dizziness. Sometimes he falls in the street. He has flatulent dyspepsia. He never has had any venereal disease. Says he has been prescribed for by "20 aurists."

For the watch his H. D. is R  $\frac{P}{48}$ , L  $\frac{0}{48}$ ; voice, 3 feet. The tuning-fork "C" is heard on the teeth "slightly"; not at all on the forehead, nor on any point of the skull, except on the tip of each mastoid. The aërial conduction is much better than the bone- on each side. His pharynx is granular. Both membranæ tympani are somewhat depressed; they are not of good color, and the light spots are small. The air enters each ear by Politzer's method, and after inflation the H. D. on the left side is  $\frac{P}{48}$ ; before it was  $\frac{0}{48}$ .

*Remarks.*—This I believe to be a mixed case, that is to

say, one of the middle ear and of the labyrinth. But I believe the disease of the middle ear to be of slight importance, and not to be the cause of the great loss of hearing and the head symptoms. In this case my diagnosis is based upon:

1. The suddenness of the symptoms.
2. The fact that the patient hears worse in a noise.
3. That he hears low tones best.
4. That music is disagreeable to him.

The variableness of his hearing power, which, however, is never good, as I found by several careful examinations, is due, I think, to the catarrh of the tympanic cavity and Eustachian tubes, which he undoubtedly has. I do not think the symptoms of labyrinthine pressure are secondary to those of the middle ear, however, because he has submitted at various times to *anti-catarrhal* treatment, with no marked benefit. Speculation as to the pathology of the lesion of the acoustic nerve is perhaps useless; yet I cannot but suppose that in this case either an inflammatory or a hemorrhagic exudation has occurred. There is no record that the patient's urine was examined. I think it was, however, with a negative result. A regular life was advised for the patient, but this he declined, and I anticipate that I shall one day hear that he has succumbed to central disease.

CASE 3.—J. J. Mc——, postal agent, æt. 40. Sent by Dr. Collins, March 11, 1881. When a boy suffered from tinnitus. Until one year and a half ago heard well. His attention was called to his impairment of hearing by his friends. *Does not hear as well on the railway cars as other people.* His occupation keeps him on the railway more than half of the time. It is worse when he is tired; appears to be in good health; never has had venereal disease; temperate. H. D., R  $\frac{0}{48}$ , L  $\frac{0}{48}$ .

Voice, about one foot from the ear, not well even there.

The bone-conduction is somewhat better than the aerial on both sides; both are feeble.

Membrana tympani of right side is hyperæmic; there is no light spot. Left side *Mt.* is pale, and there is no light spot; pharynx normal.



*Remarks.*—In this case I base my diagnosis upon the following facts:

1. Inability to hear better, or even as well as ordinarily, in the noise of a railway carriage.
2. Feeble bone- and aërial conduction.
3. Absence of nasal and pharyngeal symptoms.

I think acoustic neuritis has supervened upon a chronic non-suppurative inflammation of the middle ear; that he had an affection of the middle ear in childhood is shown by the testimony as to tinnitus, and the appearance of the drum-head.

Then again, the tuning-fork, although feebly heard through the air as well as through the bones, is rather better heard through the bones than the air. But that he had serious disease of the acoustic nerve is, I think, indicated by the fact that he not only did not hear better in the noise of a railway carriage than when in an ordinarily quiet place, but that he heard worse than people in general. This symptom I think one which is of considerable importance. I am persuaded that in all of the cases in which the human voice is heard better in a noise, there is predominantly disease of the middle ear, and that the reverse is true. Where, in a case of impairment of hearing, the human voice is not heard better in a noise, and where, on the contrary, noise is distracting and confusing, there is, I believe, disease of the acoustic nerve. The hyperæmic drum-head unattended by pain indicates, I think, hyperæmia of the whole apparatus, and I would classify this also as a mixed case, but one in which the nerve was predominantly and chiefly affected.

CASE 4.—I. W. L., æt. 19, sent by Dr. Selden, of Catskill, April 2, 1881. "On the evening of February 27th, of this year," writes Dr. Selden, "I was called to see this young man, who had just arrived from New York, where he was taken sick. I found him suffering from severe congestion of the brain, with cold extremities and surface. He was unconscious and delirious. Four days after he became fully conscious, when it was found that he was entirely deaf. There was marked vertigo, which still continues to some extent, as well as the deafness, which is total," Added to this history, I learned from his brother that his illness came

after exposure to cold and damp, while greatly overheated as a fireman on a river steamboat. He is nearly absolutely deaf, and has constant tinnitus and dizziness. Is large and well developed. He has had no venereal disease. He hears the tuning-fork when placed on the mastoid, but feebly. His vision is normal. Talks in an unnatural way, that is, without good modulation. The diagnosis is in this case not doubtful. It is descending acoustic neuritis. I gave a bad prognosis as to the deafness, and advised iodide of potassium and counter-irritation.

*June 18, 1881.*—I saw the patient again and received a note from Dr. Selden, in which he says: "In accordance with your idea, I put him on potass. iodid. and pushed it to the verge of intolerance. The vertigo has, as he informs me, left him." I found his condition as to hearing-power unchanged. His general health was excellent, his intellect sound, and I advised no further treatment.

The evidences of disease of the labyrinth in this case, to my mind, are:

1. The history of primary cerebral or meningeal disease.
2. The nearly absolute deafness.
3. Inability of the patient to hear his own voice well.

CASE 5.—P. C., lawyer, æt. 51, sent April 25, 1881, by Professor Alfred C. Post. For 18 years the patient states that he has suffered from hardness of hearing. There is no other aural symptom. He has had no sore throat, no tinnitus. He never has observed that he hears better in a noise. If he hears any better the difference is not marked. He has worked very hard as a lawyer. He is large and well developed, but looks somewhat fagged and worn. No venereal; is temperate. Never has submitted to any aural treatment. H. D. for watch, R  $\frac{5}{48}$ , L  $\frac{8}{48}$ . Voice 6' behind him. The aërial conduction is better on each side than the osseous, but the difference is not marked. The pharynx is catarrhal. Is getting worse slowly. Right membrana tympani normal.

Left, a small light spot. Common air is not felt to enter the ears by Politzer's method. Chloroform vapor is then used and is felt. The hearing distance is less after the inflation.

*Remarks.*—This is believed to be a disease of the nerves, for the following reasons:

1. The absence of any symptom but loss of hearing.

2. The results of the tests by the tuning-fork.
3. The hearing does not improve in a noise.
4. No benefit results, but rather harm, from inflation.

I think the history, in connection with the objective symptoms, leads to the suspicion that the character of the lesion, if any, of the nerve, is atrophic. It is fairly analogous, I think, to a certain class of cases of atrophy of the optic nerve.

CASE 6.—Miss F. W., æt. 16, sent by Dr. C. S. Merrill, of Albany. The patient's mother states that she discovered that her daughter heard badly a few months ago. Careful cross-examination shows that the young lady has not heard well for years, but that she has grown very much worse during the last few months. She is very skilful in concealing her defect, by watching the mouth of the speaker. Patient is a slight, delicate, nervous patient. She began to menstruate at 13 years of age. Has leucorrhœa; H. D. for watch, R  $\frac{P}{48}$ , L  $\frac{0}{48}$ . Does not hear the voice well, even when the words are spoken directly into her ear. On the right side she does not hear the tuning-fork through the air or bones; feebly on the right side, rather better through air than through bone.

Both membranæ tympani are sunken, and the light spots are irregular in shape.

By Politzer's method air is not felt to enter the ears, but the vapor of chloroform is noticed. No improvement in hearing results, but an attack of hysteria followed.

*Remarks.*—The reasons for my diagnosis of lesion of the acoustic nerve in this case are:

1. The nearly absolute deafness (absolute on one side).
2. The results of the examination by the tuning-fork.
3. The absence of annoying tinnitus.

That the lesion is rather atrophic than actively inflammatory, I think may be concluded from the general debility of the patient, and the absence of head symptoms. That it is not hemorrhagic, is, I think, tolerably well assured, from the fact that the deafness came on gradually. The disease of the nerves may have been secondary to catarrhal trouble in the middle ear. This, I think, is probable, for although I could not get a very intelligent or exact history, there

was a vague idea on the part of the mother that "colds" and "pneumonia" were the cause of the first aural symptoms.

CASE 7.—W. D. C., æt. 41, sent by Prof. Gouley June 25, 1881. This patient was sent to me, but I did not see him for some days after my associate, Dr. Edward T. Ely, had made a diagnosis, in which I fully concur.

The patient was seized with mumps three weeks ago. Deafness of the left ear appeared suddenly two weeks since. There has been dizziness for one week. This was marked in walking, in sudden movements, and in looking upward. The sensation at times is as if he were pulled backward. He says the sensations are like those from alcoholic intoxication. There was some dulness of hearing in the right ear, but that has passed away. He travelled while he was suffering from parotitis. There was no pain in the ear. He had no rational treatment for the aural trouble. Since the deafness appeared there has been constant tinnitus. In 1867 the patient had a venereal sore, and a general eruption afterward. Had no other symptoms of syphilis. He is married, and has six healthy children. Noises of the street are very annoying to him.

The H. D. R  $\frac{30}{40}$ , L  $\frac{P}{40}$  (?). The tuning-fork placed on the teeth is heard only in the right ear. In the left ear the tuning-fork is not heard at all through the air. It is heard on the mastoid, but probably by the right ear, as plugging the right ear intensifies the sound. Plugging the left ear makes no difference. The drum-heads are depressed, and the light spots are small. His voice sounds only "one-half" to him. After inflation by Politzer's method, the watch is heard when pressed upon the left ear, but probably with the right, as plugging the right intensifies it. The fork is not heard.

*Remarks.*—The diagnosis in this case is based upon:

1. The suddenness of the occurrence of nearly absolute deafness.
2. The evidence of the tuning-fork. It is heard only in the good ear.
3. Noise is distressing to the patient.

Dr. Ely made a diagnosis in this case of "Affection of the labyrinth after mumps." I believe the case

to be one of acoustic neuritis, and that the cochlea or nerve trunk are the parts chiefly involved. Whether it was a so-called metastatic inflammation, similar to metastatic orchitis, so often seen after this disease, I am unable to say. But I think it more probable that the disease passed through the tympanic cavity, where it caused a slight catarrh, and entered the cochlea through the fenestra ovalis and vestibule, or by the fenestra rotunda. In the right ear there was undoubtedly a moderate inflammatory process, which seems to have been confined to the tympanum. The access to the ear, through the auditory canal and middle ear, by the parotid gland, is certainly anatomically easy, and I do not know why we should seek out another means of communication to explain the transference or continuance of an inflammation of the parotid gland to the ear. The fact that only a slight affection of the tympanic cavity occurred, is nothing against the notion that the cochlea, which tolerates very little, while the middle ear may undergo much without great impairment of hearing, was seriously impaired as to its functions by the inflammation. There is a direct connection of the two parts of the ear, by means of blood-vessels, and I confess to surprise at the difficulty which is found by some authors in knowing how a disease passed from the parotid gland to the cochlea. I have already alluded to this fact in my text-book, p. 539, fourth edition. The influence of the venereal disease, I think, may be considered as of no account. In the treatment, however, Dr. Ely and I thought we were giving the patient the benefit of a doubt by practising inunction, and administering iodide of potassium. The patient was kept under observation for eleven days, and was treated by the use of leeches and mercury and iodide of potassium, and the avoidance of noisy places. At the end of that time he thought the tinnitus and dizziness were less; the hearing was as first noted. Judging from similar cases, I suppose this patient will recover from the distressing head symptoms, but never from the deafness. The inability to bear noise, as I long since pointed out, is, I think, a symptom of acoustic neuritis.

The cases thus presented have been taken from my case-

book of the last year. They are presented to show that with our present clinical knowledge we are able to differentiate with considerable certainty as between diseases of the middle and internal ear, and that we may perhaps even begin to isolate different forms of affections of the acoustic nerve. To my mind the tuning-fork has done much to assist us in classification. It seems to be supposed by some writers (see Burnett, *American Journal of Otology*, No. 3, 1881, p. 200) if the tuning-fork be heard in both ears when on the vertex, that no disease of the labyrinth can exist. Now I believe, even if the tuning-fork be heard in both ears, but more indistinctly in the bad ear, that disease of the nerve may be diagnosticated. I beg to refer to my paper on this subject read at the last meeting (1881) of the American Otological Society.

Diseases of the trunk of the acoustic nerve, and its expansion into the labyrinth, continue, happily, to bear a very small proportion in the total of aural affections. Hopeless as the prognosis is now in nearly all of them, we may believe that, as the acquisitions of clinical and pathological experience begin to be sifted, we shall even in this direction find much worthy of our search. Certainly, the patient will often be spared much tentative and useless treatment, if we are always able to make a diagnosis.



INVESTIGATIONS REGARDING THE OCCURRENCE  
AND THE IMPORTANCE OF COCCOBACTERIA IN  
PURULENT OTORRHOEA, AND THE THERAPEU-  
TICAL INDICATIONS FURNISHED BY THEIR PRES-  
ENCE.

By B. LOEWENBERG, OF PARIS.\*

Translated by ISIDOR FURST, of New York.

PART I.

MICROSCOPICAL APPEARANCES.

I N the initial chapter of my treatise on "Furuncle in the Ear and Furunculosis" (published in the *Progrès Médical*), I have laid stress upon the fact, that I was surprised by the excessive quantity of micrococci invariably found when I first began the examination of the pus secreted in aural furuncle. It so happened that the first patients suffering from furuncle in the auditory meatus, consulted me after the furuncles had opened and pus had been effused into the auditory canal, and when I commenced my studies upon them it remained doubtful for a time whether I had to deal with the cocci characteristic of this affection, or with other, as it were, more virulent ones. Soon, however, I was convinced that certainly not every thing found belonged to the former, and this opinion was confirmed by Prof. Pasteur, to whom I submitted a sample of these micro-organisms, who assured me positively that they were not the microbia characteristic of furuncle.

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\* To some extent taken from a paper read by Dr. Loewenberg at the International Otological Congress, Milan, September 7, 1880.

Since then I have had abundant opportunity to examine furuncles of the meatus *prior to their opening, i. e.,* before the pus formed in them had come into contact with the atmosphere. These experiments consisted in the cultivation, in beef-soup or diluted Liebig's extract of meat, of pus freshly obtained by opening the abscesses. They demonstrated with certainty that the coccus of furuncle, purely and abundantly produced by these experiments, deviates morphologically from that found in patients affected with otorrhœa; for instance, in constantly exhibiting greater dimensions.

Since acquiring this knowledge, I have repeatedly, from beginning of June, 1880, to date, subjected to a careful examination the products of secretion of the affected organ in all patients coming under my care, in order to enable me to study the nature of the respective microphytes. The examination consisted, on the one hand, in the microscopic study of the pus (with all its accompanying detritus) obtained by syringing or otherwise; on the other hand, in attempts at cultivation, partly in the above-mentioned media, partly in boiled neutralized urine. Of course, these experiments were made with all the precautions indispensable in such cases, *i. e.,* subjecting all vessels and instruments to a red heat, and parallel experiments with samples of the nutritive fluid without the addition of the pathological products. As it is possible, *a priori*, that the cotton employed for closing the vessels may contain germs, I always heated it, before use, in some receptacle—a precaution of which I can find no mention anywhere, but which perhaps is not superfluous.

These experiments demonstrated that in all these cases we had to deal with the ordinary *organisms of decomposition*. *In all cases of otorrhœa in which the cleansing of the ear is not done with the greatest care and by the aid of suitable apparatus, the pus contains more or less great numbers of micrococci. If, in consequence of persistent neglect, the secretion is allowed to become offensive, the micro-organisms swarm in incredible quantities.*

Whoever is to some extent familiar with the morphology

of the minute creatures occurring during decomposition of animal or vegetable substances, will find this fact perfectly natural; he would expect *a priori* that on admission of air stagnant pus could not long remain free from those microphytes, and that they, when decomposition has become fetid, must be met with in a high stage of development.

In this connection I state with decided emphasis that, contrary to the belief prevalent even in some competent circles, the pus secreted in simple purulent otorrhœa, in its fresh state, is as little offensive as that from other diseased mucous membranes, simply because of the absence of any cause therefor. Feter then, according to my opinion, points to stagnation and a high degree of decomposition dependent thereon, the existence of which is proved by the presence of micrococci.

Hiller expresses himself to the same effect in his book,<sup>1</sup> a work that cannot be too highly commended: "We may confidently assume that, whenever the smell of  $H_2S$  or  $H_3N$  is clearly perceptible in a dead animal body or part of it obtained from the household, putrefactive decomposition has set in and has progressed to the *formation of terminal divisional products*."

I found the most abundant multiplication of cocci where the ear had been treated with *emollients*, particularly with *cataplasms* (compare also my treatise on "Aural Furuncle," etc., *loc. cit.*). The bacteria under consideration require for their development oxygen,<sup>2</sup> warmth (particularly a temperature between  $30^\circ$  and  $35^\circ$  C.), water, and organic substances, from which they derive C and N, together with certain salts.

To be sure, they find all these aliments in an ear containing pus: a temperature very close to the central one, moisture, and organic substances withdrawn from the vital influence, viz., the pus itself and the products of the epidermo-epithelial desquamation. If cataplasms increase the moist heat and contribute additional organic materials, we have an actual hot-house culture of the bacteria. The above-men-

<sup>1</sup> Arnold Hiller: Die Lehre von der Fäulniss. Berlin, 1879, p. 63.

<sup>2</sup> S. Paschutin, *Virchow's Arch.*, Bd. lix, pp. 3 and 4.

tioned condition explains the fact well known to all experienced otologists, that after prolonged employment of cataplasms almost interminable purulent processes in the ear often remain behind. Under the just-described, certainly unintentional artificial cultivation the putrefactive organisms reach a high degree of development, and in their turn keep up the prolonged suppuration. By a similar furtherance of the development of micrococci, though of a special character, we may interpret the fact that after continued application of poultices outbreaks of furuncles may be incited in any part of the body. In this connection I cite an interesting observation made by Dr. Nepveu before the Société de Biologie, which proves that a cataplasm may not alone further the development of bacteria, but may be the *carrier* of them. According to this expert observer, in one of the Paris hospitals, "a number of bacteria and cocci were found in the linseed meal boiling slowly in a pot over the fire"; such a cataplasm not only carries the aliment required by these parasites, but also the microphytes themselves or their germs, ready for immigration and multiplication.

I now return to my special case—that of the development of micrococci in suppuration of the middle ear. Here, in all cases in which the abundant development of schizomycetes pointed to an advanced stage of putrefaction, I found the following quite surprising condition: All the coarser solid parts, particles of epidermis or aggregations of pus-corpuses, were invested with an envelope of closely packed but very small micrococci, which concentrically surrounds any and every particle of detritus to an equable depth, and in optical sections appears as a rather broad strip.

Further examinations have shown this concentrical *gelatinous envelope* to be constant in all cases in which the pus stagnates in the ear. It must not be supposed that it was a casual agglomeration, or one due to mutual attraction, but a really connected aggregation of micrococci representing a peculiar formation. It can easily be demonstrated that it was not merely a coherent layer. If strong pressure is

exerted on the preparation through the covering glass, or if a reagent or coloring matter for schizomycetes is added, or if the surrounding liquid is sucked out by blotting paper, the whole formation is often detached *in toto*, and it can be plainly seen that the several punctiform cocci are connected together by a hyaline, apparently tough mass, the fundamental substance of the concentric envelope. How tenaciously this layer adheres to every particle of detritus is demonstrated by the fact that such a relatively rough procedure as a free syringing of the ear is often incapable of detaching it—as is shown by the examination of the pathological products removed in this manner.

Evidently, we here have to deal with one of the most characteristic morphological images of putrefaction, the so-called *zoöglæa*—a constructive formation, as is well known, peculiar only to the spherical and rod-bacteria among the schizomycetes, and lacking to the others, *e. g.*, spirilli. While the several individuals of the two first-named groups of schizomycetes are rapidly multiplying by division, they form under certain conditions that muco-gelatinous, coherent, and well-defined mass which has been variously interpreted and named since the time of Burdach. The term more generally employed is that proposed by Prof. Cohn, of Breslau,—“*zoöglæa*.” Prof. Billroth distinguishes gliacocci and gliabacteria (see his work on *Coccobacteria septica*, 1874). According to the first-named author, the form *zoöglæa* must be carefully distinguished from that named by Pasteur “*mycoderma*” (this term was proposed as early as 1872 by Persoon); the latter lacking the mucoid fundamental substance which characterizes the former.

According to Prof. Cohn, the *zoöglæa* owes its origin to a process of imbibition, a swelling of the cell-membrane of the bacteria (Cohn, *Beiträge zur Biologie der Pflanzen*, Bd. i, 2, p. 141), which is greatly favored by an unimpeded access of air. With all due deference to such a distinguished investigator, I must raise some objections to this (otherwise generally accepted) mode of explanation. Even assuming the existence of a cell-membrane in the smallest of all living beings—the micrococci, as incontestably proven,

which often appear only as points under the highest magnifying powers—it appears to me very extraordinary that these undoubtedly very delicate membranes should be able to swell to such an extent as to separate the cocci to the degree often observed in this gelatinous envelope. (I propose this name, on the one hand because it saves us from a foreign term, on the other hand because zoön would designate the fungi as animals.) Besides, as far as my experience goes, the several individuals in this aggregation possess the same sharp outline as those floating about singly which do not belong to the gelatinous form, that is, they show no indication of a swelling of the membrane encircling them. Otherwise the vital qualities of the cocci seem to me to be the same there as in their free condition.

All these facts may be taken as evidence against the theory that this form arises from swelling of the cell-membrane, and I propose the following new hypothesis in its stead: *It seems probable to me that the gelatinous envelope (Zoöglœa, Cohn) is a PRODUCT OF SECRETION OF THE COCCI OR BACTERIA.* I refer to the assumption of reliable bacteriologists that these fungi are capable of excreting various substances. Thus many authors explain the toxic effects of schizomycetes in the animal body by the power these minute and at the same time powerfully active corpuscles have to excrete very deleterious substances (*e. g.*, Schröter in Cohn's Beiträge, i, 2, p. 109; Koch, etc.). In analogy with these facts I assume that the gelatinous envelope is the optically recognizable product of a similar excretion, and this hypothesis appears to me more plausible than the one hitherto prevalent, in view of the objections above specified.

It is well known that a similar formation of gelatine occurs also in other low organisms, *e. g.*, in the monocellular algæ (comp. Prazmowski, cited in *Botan. Centralblatt*, 1880, p. 37). It may also be observed in *Euglena viridis*, and in that case has even been taken as a specimen *sui generis* and named "microcystis Nolti." *Euglena* is said to be a plant, not an infusorium, as hitherto believed. (Hofmeister, "Handbuch der physiologischen Botanik," i, p. 29, Note 4, 1867.)



## SPECIAL MORPHOLOGY OF THE MICROPHYTES FOUND IN OTORRHŒA.

I.—*Micrococci or Spherical Bacteria.*

I have stated above that the cocci which I observed in the stagnant pus of otorrhœa, are absolutely the same as those ordinarily occurring in putrefactive decomposition. They appear as exceedingly minute punctiform or slightly oblong corpuscles. Often several may be seen grouped in a manner which would lead us to suppose a preceding multiplication by division, which manner of propagation, it is well known, is peculiar to the entire class, and has given rise to the names of schizomycetes or schizophytes.

Frequently chains of two, three, or more are found arranged lengthwise; again, groups of four or five in pretty cross form. As appears from a communication to the *Centralblatt f. d. med. Wissensch.* (July 12, 1879), Dr. Neisser regards this crosswise arrangement as characteristic of gonorrhœal pus, but I can give the assurance that I have frequently found it in the product of simple otorrhœa.

II.—*Rod-bacteria.*

In speaking heretofore only of micrococci without naming other groups from the class of schizophytes, I did so because, in the vast majority of the cases examined, the former structures alone were present. This fact is not surprising to those familiar with the microscopic examination of putrid substances; on the one hand, it is just these organisms which in the decomposition of organic tissue appear first and play the chief part; on the other, their occurrence is especially characteristic of animal fluids abounding in albumen, because they stagnate on free admission of air. Under these circumstances Prof. Billroth already observed only the smallest forms of schizophytes in pus and blood, and Dr. Hiller also observes (*loc. cit.*, p. 299): "In albuminous media, *c. g.*,

blood, pus, and animal tissues, the small form of cocci usually predominates—at all events, it always appears first.” During the stagnation of pus in the middle ear and in the meatus, quite analogous conditions prevail, and the identity of the microscopic images in both cases, therefore, is any thing but surprising.

Having sufficiently emphasized that in all cases where the strictest cleanliness is not observed (and, as we shall see later on, appropriate treatment instituted), spherical bacteria show themselves as the peculiar typical concomitants of suppuration of the ear, I must yet add that I certainly found rod-bacteria likewise, in a few cases. In view of the theoretical and practical importance of the subject, I think it imperative to report these cases more in detail.

I. *First observation.*—D., æt. 13, is brought to me October 13, 1880. The patient, a weakly child of scrofulous habit, exhibits the tooth-formation described by Hutchinson, and suffers from bilateral keratitis. A few weeks ago, it is said in consequence of using Weber's nasal douche, an acute inflammation of the drum-cavity of the right ear ensued, which soon terminated in perforation and suppuration. Treatment to date: instillation of a weak solution of alum, occasional syringing of the ear. The latter part of the treatment has evidently been insufficiently performed, for the fundus of the right meatus is filled with a brownish, smeary, offensive mass. After careful syringing, a very large perforation is seen in front of and below the manubrium mallei. The mucosa of the drum-cavity is slightly reddened; otherwise nothing notable is to be observed, the case generally exhibiting nothing extraordinary except in the microscopic appearance.

*Microscopic examination of the matter obtained by syringing.*—All fragments, such as remnants of epidermis, aggregations of pus, etc., are surrounded by the concentric micrococcus-gelatin; besides, there are some small *rod-bacteria* with their characteristic motion. With these are seen some peculiar, not easily explained formations, namely, ellipsoid or lemon-shaped bodies, of equal size with the accompanying epithelial cells and full of punctiform granules. They bear a remote resemblance to Prof. Billroth's ascococcus, only the latter form has a more irregular outline, and, according to their discoverer and Prof. Cohn (*loc. cit.*, i, 3, pp. 151 *et seq.*),

they are enclosed in a gelatinous envelope, while the bodies here seen are quite free and have a distinct outline.

### *Results of Cultivation.*

With small quantities of the recently evacuated masses I made attempts at cultivation, observing the customary precautions, and obtained the following results :

1. *Cultivation in fresh and alkalized beef-soup.*—(The temperature of the room varied between  $10^{\circ}$  and  $15^{\circ}$  Cent.) On the day following the beginning of the experiment, vast increase of the micrococci, while the bacteria have not multiplied at all, or only very slightly. The cocci form chains; in some places I observed the following *phenomenon*, not previously described, to the best of my knowledge. Two clearly distinct cocci, in vivid molecular motion, tear one another hither and thither, as if joined by a bond invisible to our highest powers. Perhaps we had here a stage immediately preceding a definitive fission?

*On the second day after commencing the experiment*, the liquid has an acid reaction and exhibits brisk development of gas. It contains many rather oblong micrococci, united into chains or hives. Here and there are seen some coarser granules which do not consist of fat, as shown by the refraction and reagents. Of bacteria there are only some extremely sparse imperfectly developed specimens.

2. *Cultivation in fresh beef-soup without the addition of alkalies.*—Temperature as above; cocci and bacteria likewise, but much more sparsely developed. On the fifth day after the beginning of the experiment, a very unpleasant odor is perceptible in the nutritive fluid, somewhat like decaying fish; there is no evolution of gas. Positive absence of bacteria.

I state in this connection that the vast increase of the smallest corpuscles during the attempts at cultivation proves that I have not made the mistake occasionally committed by some authors, of mistaking granules of detritus for micrococci. It is well known, and I have called attention to it elsewhere (treatise on "Furunculosis"), that granules of detritus resulting from the decomposition of tissue may at times be easily mistaken for cocci, particularly in certain media, in which reagents and staining fail us (see *c. g.*, Cohn,

Beiträge, Bd. i, 2, p. 149). For such doubtful cases I recommend attempts at cultivation (preferably on the heated stage); they will certainly decide whether the one or the other kind of corpuscles are present, because micrococci multiply rapidly in congenial fluids, while particles of detritus of course remain *in statu quo*. I do not recollect to have seen the recommendation of this simple method in any other place.

II. *Second observation.*—Mr. T., æt. about 40, consulted me on October 4, 1880, for a chronic eczema of the right external auditory meatus. This affection, it is well known, causes troublesome itching, and in consequence thereof reckless scratching, often leading to quite serious complications for the ear. Thus, in Mr. T., at that part of the osseous meatus where he used to scratch with particular violence, is seen an oblong narrow strip in which the probe *encounters rough bone*. Microscopic examination of the scant, very fetid secretion shows the characteristic coccus envelope, together with some minute, very active bacteria.

III. *Third observation.*—" *Bacterium capitatum*."

This is one of the first cases in which I recognized the other above-described forms while trying to find, in furuncles of the ear, the micrococcus which Prof. Pasteur had discovered in furuncles of various parts of the body.

The patient, a lady of 73, and belonging to the highest circles, had, before seeking my assistance, according to her statement, a series of furuncles in the right auditory canal. The treatment consisted in the application, or rather the introduction, of cataplasms which the patient made herself, of pointed shape and small size, to enable her to introduce them deep into the meatus. All inflammation had ceased some time since, and patient consulted me merely for the impaired hearing in the right ear.

On examination, I found the right canal quite filled with various masses, partly of purulent, partly of epidermoid nature, together with all sorts of detritus. Immediate microscopic examination exhibited the usual cocco-gelatinous envelope, besides real (rod-) bacteria, many of which had the following quite peculiar form: At one end they had a swell-

ing, strongly refracting the light, approximatively at least twenty times the size of the cocci floating around them. Some of these bodies were also seen free, that is to say, unconnected with bacteria.

To some extent they resembled fat-globules, at least in their refractive power, but were distinguished from them by their peculiar shape, their constantly even size, and their behavior toward reagents, as, for instance, ether, which latter could be successfully employed, there being no mucoviscid medium present.

To the best of my knowledge, the first description and illustration of a similar form appeared in the—for that time—excellent book of Perty (*Zur Kenntniss kleinster Lebensformen*, 1852, see fig. 26, *b, c, d*, *Sporonema gracile*). Corpuscles of similar shape, but consisting of starch-flour, were described in 1868 (*Comptes Rendus*) by Trécul as amylobacter, urocephalum, etc. Davaine observed bacteria with expanded extremities in a fluid of maceration, and described them as *Bacterium capitatum* (*conf.* his article, *Bactérie*, in the *Dict. encycl. des Sc. Méd.*, Bd. viii, 1868, p. 24). According to Cohn, such a form produces the peculiar ferment which changes milk into cheese and is identical with Pasteur's ferment butyrique. (See Cohn in his *Beiträge*, Bd. i, 3, p. 194, *et passim*; Pasteur, in *Comptes Rendus*, 1864, Jan. 18th.)

More recently, Billroth's investigations have advanced the subject materially; according to him, the strongly refractive corpuscles are simply the *persistent spores* (or persistent ascos spores) of the "cocco-bacteria." It is they which, despite heat, cold, drying, and other physico-dynamic influences, effect the continuation and spread of schizophytes. In respect to appearance and micro-chemical behavior, the corpuscles observed by me corresponded closely with Prof. Billroth's persistent spores (comp. "*Cocco-bacteria septica*," by the same author, plate iv, fig. 37, especially the upper part of the figure).

Compare also the interesting article by Dr. Koch on the spores of *Bacillus anthracis* (in Cohn, *Beiträge*, Bd. ii, pp. 287 *et seq.*, with excellent photographs of these minute

objects), and his pamphlet: *Ueber die Aetiologie der Wundinfectionskrankheiten*, 1878.

If in the present case the peculiar corpuscles must be regarded as spores of bacteria, it may be asked why such "proliferation" should have occurred just here, as opposed to the other observations made by me. Was it, perhaps, the continued filling of the auditory meatus with cataplasms, together with the products of inflammation and suppuration, which gavè rise to such a forced cultivation, the favorable conditions for which were lacking in the other cases? This, of course, is nothing but a hypothetical explanation.

In connection with these special microscopical studies, I am reminded of a verbal communication made to me by the late Prof. F. A. Pouchet, of Rouen, who, as early as 1864, informed me that he had found bacteria in the pus of a case of otorrhœa whenever itching had been present. I frankly admit that at that time my attention, as well as that of the entire medical world, was but little directed toward these micro-organisms in reference to their pathological importance, and I did not recall that remark to mind until my investigations into the occurrence of schizomycetes in ear-affections had yielded the results here reported, and when I was surprised by the absence of the actual (cylindrical) bacteria in most cases (see also *Comptes Rendus*, November 4, 1864).

#### IV and V.—*Observation of bacilli (bactéridies) in peri-auricular abscesses.*

Although the following two cases, strictly speaking, touch upon points outside the limits of the present paper, I yet report them as a contribution toward the settlement of the question as to the occurrence of microbia in closed collections of pus.

IV. *Fourth observation.*—Prof. X., a famous *savant*, was directed to me by my friends, Drs. Noyes (New York), Dalby (London), and Pratt (Paris). Briefly, the case consisted in a violent exacerbation of a chronic perforating suppuration of the



middle ear. Some days since, the inflammation had extended to the surroundings of the meatus. On my first examination, the latter was found occluded about its middle by inflammatory swelling, and the surrounding cellular tissue, especially above anteriorly, was most intensely inflamed. Soon a colossal abscess formed in the temporal region. When it was opened, odorless, but very turbid, cloudy, unhealthy-looking pus of a pink-violet color was evacuated. It contained, according to microscopic examination, countless bacilli of enormous length. I beg to state here, however, that I had no microscope at hand when I opened the abscess, and that the unusual appearance of the pus induced me to take a sample of it with me for examination at home. On the following days the pus retained the same appearance with like contents. Despite this hiatus in the examination, the bacilli existed undoubtedly in the unopened abscess cavity, and did not possibly form subsequently in the brief time which had elapsed between the opening of the abscess and the examination of the pus. On the one hand, there was absolutely no time for such an enormous development; on the other, if these microphytes had been putrefactive bacteria, micrococci would have developed first, and much later, if at all, the cylindrical forms would have appeared.

A communication of the abscess cavity with the meatus or the drum cavity could not be demonstrated.

The opening and after-treatment of the abscess were done according to Lister's principles (without spray, however). Although during the entire course of the suppuration the excreted masses retained the same unhealthy appearance and contained bacilli, the cavity closed entirely in about two weeks.

The blood of the patient was unfortunately not examined; it must be stated, however, that he was diabetic to a high degree.

V.—*Fifth observation.*—About two months ago, I had the opportunity of observing a case similar to the above, which I shall briefly refer to. The patient was a *conciierge*, somewhat anæmic, æt. 35. According to his statement, a swelling had formed in the neighborhood of the left ear, accompanied by pain, increasing until almost unbearable, but without simultaneous symptoms of

inflammation in the ear itself. When I first saw the patient, he was almost raving, owing to the pain which had plagued him for four or five days uninterruptedly. An immense tense swelling extended around the external ear, with the exception of the region below the meatus. Membrana tympani and meatus normal, barring a moderate injection. A free incision evacuated an almost incredible quantity of pink, odorless pus.

Immediate microscopic examination of the pus by means of an excellent Zeis' oil-immersion lens and Abbe's illuminating apparatus shows sparse bacilli; with these are seen stramonium-shaped or stellate red blood-corpuscles.

Immediate cessation of the pain; treatment according to Lister (drainage, etc.), and complete cure in a very short time.

Having reported in this part the result of my study in regard to the presence of schizomycetes in aural affections, I shall proceed hereafter to the interpretation of my results, and see to what extent they are applicable for rational therapeutics, especially in chronic perforating suppuration of the middle ear. The last two observations (IV and V) will not again be referred to, not being of special otological interest, and belonging rather to general bacterio-pathology. I may add here that the treatment I employ consists in a combination of boracic acid and alcohol—either in alternate application or in instillation of an alcoholic solution of boracic acid.

*(To be continued.)*

## ON THE EXFOLIATION OF THE NECROSED SMALL BONES OF THE EAR.

BY DR. OSCAR WOLF, OF FRANKFORT-ON-THE-MAIN.

Translated by JAMES A. SPALDING, M.D., Portland, Maine.

A RECENT and rare case, under my own observation, of exfoliation of the malleus, has led me to look more carefully over my notes of cases of *necrosis of the small bones of the ear*. *Carious necrosis of the small bones of the ear* cannot of course form a special theme for discussion, like, *e. g.*, otitis media acuta; for it is almost without exception a secondary phenomenon, associated with caries of the middle ear. Still, it is interesting enough in a pathological and etiological point of view, as well as in the frequency of its appearance and its relations to deafness, to demand some special consideration.

The early literature bearing upon this point is rather bare, in spite of the fact that scarlatina, to which the disease under consideration bears the closest relationship, has found an extraordinary number of interpreters.<sup>1</sup> Rilliet and Barthez<sup>2</sup> report but two cases of their own of otorrhœa after scarlatina; Underwood-Schulte (1848) mention caries of the petrous bone and exfoliation of the small bones as one of the sequelæ of scarlatina, and Bouchat (1867) speaks of "otitis, with perforation of the *Mt*, loss of the small bones, and caries of the petrous bone." Gerhardt<sup>3</sup> (1861),

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<sup>1</sup> Compare, Thomas, *Ziemssen's Encyclopædia*, § Scarlatina. (English translation.)

<sup>2</sup> *Traité des maladies des enfants*, tome I, p. 196, 1844.

<sup>3</sup> *Lehrbuch der Kinderkrankheiten*, p. 92.

Henning (1864), and West (1865) say about the same thing, while Vogel (1865) enters more deeply into the pathogeny of this complication of scarlatina, and regards the severe affection of the middle ear as a propagation of the diphtheritic process along the mucous membrane of the tubes.

Various works on otology in the last ten years (Yearsley, v. Tröltsch, Moos, Josef Gruber, and Harvey) give minute descriptions of the origin and course of defects in the *Mt*, in suppuration of the middle ear, due to the acute exanthemata, while I myself have described in a series of cases the disturbances of hearing which are noticed after loss of the small bones. It is easy to see why the books on diseases of children do not offer us more material, when we consider that the diagnosis of loss of the small bones demands that practice on the part of the observer which can only be gained in time by the development and extension of scientific otology.

Further on, I shall mention more carefully the *special* cases of necrosis of the small bones, which have been published by v. Tröltsch,<sup>2</sup> Schwartze,<sup>3</sup> Moos,<sup>4</sup> and more recently by Burkhardt-Merian.<sup>5</sup>

In order to discover the *frequency* of the exfoliation of the small bones, I had to look through my own series of over 6,000 cases, because the literature at my command gave me no hints in this direction. I found 28 cases,<sup>6</sup> single or double, of loss of the small bones, *i. e.*, 4.3 in every thousand cases, which is suprisingly small, and yet seems perfectly correct, when we consider that only genuine cases have been included in the list. The specialist usually has but few chances of observing the *process of exfoliation*, because energetic and early interference in the acute stage of the disease may prevent this occurrence, or because the process is already ended when the patient

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<sup>1</sup> "Sprache und Ohr," p. 107, *et seq.* (1871).

<sup>2</sup> *Archive f. Ohrenheilkde.*, Band vi, Heft 1, p. 55.

<sup>3</sup> *Handbuch f. Path. Anat.* Klebs, *Gehörorgan*, p. 87, *et seq.*

<sup>4</sup> *Zeitschrift f. Ohrenheilkde.*, Band viii, Heft 3, p. 217, *et seq.*

<sup>5</sup> Volkmann's *Vortraege*, No. 181.

<sup>6</sup> Only the loss of the malleus and incus is here considered, because the rarer occurrence of exfoliation of the stapes, cannot always be accurately diagnosed during the life of the patient.

is seen at a late stage and only after convalescence from the general febrile affection.

It is, nevertheless, a pleasurable fact to notice in recent years that the most severe types of necrosis have been far rarer than of old,—which proves that specialists have gained a broader knowledge of the significance of an early and scientific interference with the disease. Still, we do not mean to say, that destructive necrosis may not appear even nowadays, in spite of careful and early treatment, when the disease of the ear is due to a malignant form of scarlatinal diphtheria.

*Pathogeny and etiology.*—Most of these cases of exfoliation are due to the so-called exudative necrosis in scarlatinal diphtheria. It is, *a priori*, easy to understand that just as the diphtheritic exudation causes greater or less structural necrosis of the tonsils, arches of the palate, larynx, and even of the conjunctiva and cornea, so those portions of the tympanum which lie close to the regions most affected by the disease, are likewise affected by the exudation. I fully agree on this point with the opinion of Heydloff<sup>1</sup> and Burkhardt-Merian (*l. c.*, p. 1493), while the fact that I have often found cicatricial contraction, and even closure of the tubes, in cases of loss of the small bones, also indicates that the diphtheritic process is propagated from the pharynx to the tympanum along the tubes.

Still, the diphtheritic exudation alone is not the only cause, as is shown from my catalogue, for there we find, scarlatina, 18 times; scrofula, 2; typhus, 2; measles, 1; periparotitis, 1; diphtheritis, 1; acute tuberculosis, 1; while in 4, no general constitutional affection could be discovered.

Exfoliation of the small bones is very rare without the accompaniment of some constitutional disease, because diminution in the general circulation and defective nutrition of the small bones, must be present, in conjunction with the excessive hyperæmia and congestion arising from the inflammation of the middle ear, in order to lead to acute necrosis. Caries of the tympanum is due, in many cases,

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<sup>1</sup> Ueber Ohrenkrankheiten als Folge und Ursachen von Allgemeinkrankheiten. Inaug. Diss., Halle, 1876, p. 8.

solely to the fact that perforation of the *Mt*, and consequent diminution of pressure on the neighboring portions of the tympanum, enclosed as they are in resisting walls, does not appear early enough for the regulated supply of blood to restore the disturbance in the nutrition of the bone.

The *incus alone* was exfoliated six times in the above 28 cases, the *malleus alone* in two cases, which confirms the view already expressed, since the malleus is nourished not only by the vessels of the tympanum through the art. tympanica, but also from the external meatus. For, as is well known, a moderately large branch of the art. auric. profund. runs from the upper wall of the meatus along the handle of the malleus, sends terminal branches into the so-called Gruber's cartilaginous tissue,<sup>1</sup> and thus nourishes the handle from the external surface.<sup>2</sup>

Twenty-one of the twenty-eight patients lost the small bones of one ear, seven of both ears. *Scarlatina* was the cause of the aural affection in 4.77 per cent. of Yearsley's cases, in 4.35 per cent. of Burkhardt-Merian's (*l. c.*, p. 1492), and in about 4 per cent. of mine. In 18 out of 266 cases under my observation, the malleus and incus were gone, so that 1 in every 14 cases of otitis due to scarlatina, lost the small bones by necrotic exfoliation.

The other patients had greater or less defects in the *Mt*, with or without erosion of the exposed handle of the malleus; in a minority of cases, the *Mt* was preserved, although thickened or cicatricial. In *scarlatinal otitis* we can distinguish three forms of disease, which develop themselves in proportion to the gravity of the constitutional affection, or are influenced in character by the treatment employed.

a. The *sub-acute* form, with sero-mucous secretion, without a necessary perforation of the *Mt*.

b. *Acute otitis media purulenta*, in which perforation of

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<sup>1</sup> J. Gruber : Lehrbuch der Ohrenhkd., p. 138.

<sup>2</sup> Moos, "On the Blood-vessels of the *Mt* and Handle of the Malleus" (These ARCHIVES, vol. vi, p. 574), shows that some of the branches given off from the distribution of the art. auric. profunda, penetrate Shrapnell's membrane and surround the neck of the malleus, while the main artery of the handle, likewise arising from the art. auric. prof., courses along the handle in the cuticular layer of the *Mt*, and distributes a few branches to the *periosteum* of the lateral portion of the handle and its angles.



the *Mt* is rather due to the pressure exercised by the secretion, than to erosion.

c. The *exudative, necrosing form*, in which either the *Mt* alone undergoes rapid and extensive decay, or is accompanied with a more or less deep-seated caries and necrosis of the bony parts.

The *symptoms and course* of otitis in severe constitutional affections have been so often and so minutely described, that I will pass them aside, and pay special attention to the *exfoliation of the small bones*. As I have already said, the extensive disturbance of nutrition in the acute stage, forms the foundation of the necrosis; the subsequent proliferation of granulations around the diseased ossicle is merely a copy of the same process of exfoliation which we may see in other bones of the body. A disagreeable secretion of pus persists for several months, until some day the exfoliated bone is seen in the water syringed from the ear, or it is extracted by the surgeon. The incus is usually the first to be exfoliated, the malleus generally follows after a short interval.

If the rest of the tympanum is free from carious patches, the secretion diminishes rapidly and loses its fœtid odor. The following case may serve as an example:

*Severe scarlatina; otitis media acuta purulenta; abscess of the lungs and empyæma; exfoliation of the necrosed incus and malleus, right; large defect in Mt, left ear.*

R. H., æt. 8, January, 1869. Severe scarlatina. On the sixth day he had violent pain in his ears, and soon became so deaf that he could hardly hear any sounds at all. Before the *Mt* became perforated, the boy had chills and pyæmic symptoms, which were followed in a few days by abscess of the lungs and empyæma. The latter was operated upon, but the suppuration continued several months until the fistula closed. The patient was so dangerously affected that his ears could not be treated till May, 1869.

The *right* meatus contained a yellow body which fell out on syringing the ear, and was recognized as the incus, with a carious patch on its larger limb. The malleus was still *in situ*, but dislocated, turned on its long axis. It was easily extracted with the

forceps a few days later. It was slightly eroded on the surface directed toward the outer tympanic wall. The offensive discharge soon ceased; the tympanic mucous membrane became reddish-yellow, but hearing remained very slight.  $L \ v \ \frac{4}{6} \text{v}$ ,  $w \ \frac{1}{\infty}$ , faint.

The *left* ear showed total loss of the *Mt*, and erosion of the end of the handle. The section diminished after a few weeks of treatment, and hearing increased to  $L \ v \ \frac{1}{6} \text{v}$ ,  $w \ 2''$ . The tubes were patent to Politzer's experiment. I have lately seen (after twelve years) the young man, healthy and robust, who came for an opinion as regards his liability to be drawn for military service.

There is no doubt that the pyæmia had depended on the absorption of pus from the tympanum.

The following cases show the terrible destruction which scarlatinal diphtheria and diphtheritis may cause.

*Scarlatina with diphtheritis; exfoliation of the necrosed small bones of both ears, and of the posterior wall of the left meatus; facial paralysis; closure of the tubes; labyrinthine disease.*

Carl N., æt. 13, June, 1876. The patient had suffered from scarlatinal diphtheria four months before, becoming deaf on the sixth day of his illness. He subsequently had an offensive discharge from his ears, right facial paralysis, and nephritis in the third week of the disease.

At my first examination I saw the *right* malleus lying transversely across the field of vision, and turned on its axis. It was easily removed with the forceps, and its head found extensively destroyed by caries. The incus had already been exfoliated. A large polypus, containing a bit of necrosed bone from the posterior wall of the meatus was removed from the *left* ear. Both small bones had already been destroyed. *Both tubes had become consolidated* with large cicatrices on the arcades and at the posterior wall of the pharynx. The hearing was totally lost.

The necrosis in this case had rapidly attacked the facial canal, and caused the paralysis of this nerve. The diphtheritic exudation seems to have greatly interfered with the function of the labyrinth also, for the large  $c^\circ$  and  $a^\circ$  forks could only be felt by bone-conduction from the vertex of the head, while perception of speech was destroyed.

*Diphtheria; necrotic destruction of the mucous membrane of the mouth and pharynx; closure of the tubes; loss of the right eye, and of the small bones in both ears.*

Barbara B., æt. 9, was attacked with diphtheria in June, 1877, and came under my treatment in June, 1879. She lost her two younger sisters from diphtheria on the tenth and twelfth days respectively, of the disease. The child had deep, cord-like cicatrices at the angles of her mouth, a sharply-defined defect in the left palatal arch, which looks as if it had been punched out, while the right eye has been lost, and lies sunken and atrophic in the orbit. Both ears are filled with cheesy masses, the tympanic mucous membrane is covered with granulations, the small bones are lost, and both tubes are closed. The father tells me that "small bones" dropped out of the patient's ears in the eighth or ninth week of the disease. Hearing: *Right*,  $w \frac{1}{x}$ ; *l v* 8'; *Left*, *l. v.* 2'.

All of the cases of exfoliation of the necrosed small bones which I have noted in my own practice, or collected from literature, have depended upon some acute constitutional affection. I have never heard of but one case of a *primary or slowly progressive constitutional* affection, *terminating with exfoliation of the small bones*, unless an acute constitutional disease, with acute otitis media had preceded it, although a few *autopsies* have favored the view of a *primary* *ostitis* of the small bones.

This single case of my own is interesting in a pathological, as well as in a physiological, point of view.

*Primary* *ostitis of the malleus, with exfoliation of the same after necrosis. Recovery with relatively good hearing.*

Mrs. G., æt. 30, previously well, but delicate and pale, came under my charge December 1, 1880. Her father, æt. 56, has *tabes dorsalis*; her mother, carcinoma of the uterus. The patient has noticed an irritating and offensive discharge from her *left* ear for five months, together with a feeling of fulness and moderate deafness. She has had no pain nor roaring.

Hearing: *Left*,  $w$  1 cm.;  $w v$  25 cm. Forks,  $c^{\circ}$ ,  $a^{\circ}$ , and  $a'$  are heard distinctly by aerial conduction, but weaker than in the *right* ear. On the other hand, they are heard louder in the *left* by bone-

conduction from the vertex. Hearing is much increased in the left ear by bone-conduction from the temples and mastoid process. The right ear is normal.

The left meatus contains a thin and offensive secretion. Only the lower and thickened portion of the *left Mt* is visible, while the upper portion is covered with granulations, which project from the region of Shrapnell's membrane. Air enters the tubes with difficulty by Politzer's method, but subsequently the patient's head feels clearer. The sharp spoon was used to remove the granulations, and while so doing I felt rough bone. The hollow of the spoon contained numerous black particles of carious bone. The hemorrhage was slight. Boracic acid was subsequently applied. The operation was repeated on the sixth day, owing to the reappearance of the granulations. While operating I pushed the spoon backward and upward to scrape off the carious edge of the tympanic ring, and felt a loose bit of bone. But after syringing the ear I was not a little surprised to see the exfoliated and carious malleus lying in the basin. The end of the handle was missing. The operation caused but little pain, and the hearing was but slightly altered. The secretion soon diminished, and on the eighth day after exfoliation of the malleus the meatus was dry and the patient very cheerful, for she heard better, while the feeling of fullness had disappeared. On the fourteenth day after the operation, Dec. 21st, the following interesting condition was discovered :

*Mt* wholly concave, tendinous, gray, and thickened, but *quite movable*, while the region of the handle was distinctly indicated by a vessel which ran varicosely and tortuously over the umbo. A projection of bone (recognizable as such by the sound) in the neighborhood of the short process gave the whole bottom of the meatus the very same appearance that one sees every day in chronic catarrh of the middle ear, with its concave and thickened *Mt*, foreshortened handle, and projecting short process. The only difference was a deep, sickle-shaped cicatrix in the Rivinian notch, which closed over a gap in the osseous tissues.

The further treatment consisted in the use of Politzer's bag, after which the hearing always increased in a moderate degree. At the end of the sixth week the hearing was as follows :

T. F. louder, *left*, from the vertex ; *w* 5 *cm.* ; *vv* 6 *cm.* ; Politzer's acoumeter 40 *cm.* I would here call attention to the fact that the patient was very intelligent and attentive, and that in my repeated tests of the hearing for the voice and watch, I always closed

her right ear hermetically with a plug of wadding covered with wax.

Examination with the *consonants* showed the remarkable fact that the explosive sounds, *b*, *k*, *t*, which possess a relatively slight strength of tone,<sup>1</sup> were heard proportionally further than the hissing sounds, which are usually the most audible. The *f* sound was heard worst of all. The relative *b* sound was substituted for *m*. The letter *r* (with the end of the tongue), if uttered alone, was heard at 2 *m*; the explosives *b*, *k*, and *t* at 4.5 *m*; the hissing sound as 6 *m*; while with the normal ear *b* is heard at 5 *m*; *r*, 12 *m*; *k* and *t*, 18 *m*; *sch*, 60 *m*. Words beginning with *t*, *r*, *d*, and broad *a* were heard, when whispered, at 6 *m*, while those beginning with *f* were only heard close at hand, owing to the weak perception of the *f* sound.

*Remarks.*—These tests show that the human *Mt* makes wide excursions when exposed to the action of the explosive sounds,<sup>2</sup> for it is only in this way that we can explain their extraordinary good perception. The greater excursion of the *Mt*, when the explosive sound was spoken, in connection with the associated increase of aërial pressure, caused the membrane to approach the incus, and in this way allowed a more exact transmission to the oval window. The diminished adaptation of the apparatus of hearing, dependent upon the loss of the malleus, could best be compensated for, in case of the explosive sounds, when the centre of the *Mt* approached the incus.

The tests also prove the noteworthy fact that hearing may be very good, even for weak tones, in spite of the loss of the malleus.

I think the picture of the *Mt*, at the last time I saw the patient, was in the following way: After loss of the malleus the concave *Mt* sank backward upon the anterior spur of the incus, which counterfeited the short process. The handle was likewise counterfeited by the vessel still remaining in the periosteum.<sup>3</sup>

<sup>1</sup> Compare "Sprache und Ohr," page 71.

<sup>2</sup> Compare, also, Blake. These ARCHIVES, vol. vii, page 457.

<sup>3</sup> The only similar case of which I know is the one by Moos, already mentioned (these ARCHIVES, vol. ix, page 30), in which the necrosis was due to pharyngeal diphtheritis. Moos says: "After closure of the perforations the

The case which I have here reported does not offer much assistance in solving the existence of a *primary otitis or periostitis of the small bones of the ear*, as raised by v. Tröltsch<sup>1</sup> and Schwartz<sup>2</sup>, and recently discussed by J. Gruber.<sup>3</sup> We simply see the bone gradually necrose, and then a recovery after exfoliation of the necrosed portion of bone, in a case without severe pain and not preceded by an acute otitis media. In a casual point of view, it may be repeated that the father of the patient suffers from tabes, the mother from carcinoma of the uterus, so that the patient may inherit a diminished vascular resistance.

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region of the manubrium was occupied by a very deceptive, white, narrow streak, while the region of the short process was denoted by a slight projection." The hearing was much less than in my case, owing to extensive changes in the tympanum.

<sup>1</sup> *Archiv f. Otol.*, Band vi, Heft 1, in which he speaks of finding the body of the incus in a state of otitis, in a patient who had died of typhus fever.

<sup>2</sup> Klebs: *Handb. d. patholo. Anat.*—*Path. Anat. d. Ohres.* Schwartz says: "There is no question about the appearance of *primary otitis*."

<sup>3</sup> *Lehrbuch*, page 495, describes a specimen from a deaf-mute: "The incus was dislocated from both hammer and stirrup, and found lying at the entrance into the mastoid cells." The *Mt* and malleus were nearly normal.



## ON THE USE OF RESORCIN IN AURAL PATIENTS.

BY DR. E. D. ROSSI, OF ROME.

Translated by JAMES A. SPALDING, M.D., of Portland, Maine.

(*Preliminary paper.*)

SINCE March, 1880, I have experimented and am still experimenting with resorcin, a parabioxybenzole which was discovered by Hlasiwetz and Barth in 1864, and introduced into medico-chirurgical practice in 1877 by Andeer.

Leaving to future practice to discover the more especial indications for the use of this remedy in otology, I will merely say at this point that I have so far used it in more than 200 cases of otitis med. purul. chron., and feel myself justified in claiming that *no* remedy at my disposal has ever given me such substantial results in this obstinate affection as resorcin. Even in those cases in which caustics had been used in vain *for months*, resorcin has brought about a perfect cure, and sometimes in an astonishingly brief time, after five or six applications.

This remedy is soluble in alcohol, glycerin, and water. I have used it *pure*, or in aqueous, or alcoholic solution, 4:100.

I have never noticed any toxic symptoms, or severe irritation, or any signs of the caustic action which have been attributed to this drug. In one case the gums were irritated as during mercurial inunction. Vomiting was also noticed once.

It seems to me that the *great therapeutical value* of resorcin depends upon its antiseptic properties, so that I feel justified in placing it side by side with phenic and salicylic acid, inasmuch as it is more easily borne than these latter remedies, and especially in the middle ear.

From this point of view I have undertaken numerous experiments, in order to decide upon the action which the remedy under consideration exercises upon the microscopic organisms contained in pus from the ears.

I propose in due season to publish the experimental as well as the practical results which I have obtained.

## MINOR OTOLOGICAL CONTRIBUTIONS.

BY DR. G. BRUNNER, OF ZURICH.

Translated by JAMES A. SPALDING, M.D., of Portland, Maine.

I. *Total deafness on both sides after a fall against the forehead. Diagnosis: Fracture of the base of the skull.*

K. B., a master-joiner, æt. 52, and in perfect health, made a misstep, fell down some cellar stairs (6 or 8 steps), and struck his forehead against a wall. He became suddenly deaf, and had to be carried to bed. He soon felt better, and was about to leave his bed on the following day, when he became so dizzy that he had to make an effort to prevent himself from falling. The vertigo lasted three days, accompanied with occasional vomiting, and then gradually disappeared. The patient had bled slightly from his mouth soon after the fall; *on the other hand, a clear fluid fell drop by drop from his nose during the first two days after the accident.*

The patient says, that for the first few days he could still hear a little, but that later both ears became totally deaf, so that he could no longer hear his own voice. *Subjective noises* of various sorts were also observed, *e. g.*, a violent roaring and rushing in the head, like the noise of a turbine wheel, intermingled with sharp, clear tones like those of a music-box, and, in the early period after the injury, *complete melodies, as if played on a hand-organ.*

When I first saw the patient, four weeks later (Sept. 12, 1880), his general health was again perfect, the vertigo had disappeared, and was not even produced by rapid revolution of his head. When he looked suddenly upward, he would occasionally feel somewhat dizzy. The deafness, however, had not improved in the slightest degree. The patient could not hear his own voice,

nor the loudest shouting, nor the report of a musket, nor bells. Still, there were a few days, during the treatment (Sep. 24th), when he declared that he could hear (not merely feel) the large fork (*E*) from the vertex of his head. But he could not tell precisely whether he felt or heard the staff-shaped fork (*C*), or the prismatic fork (*C'*) when held in the same locality.

The subjective noises had decreased in violence, but were still very annoying. In the right ear they seemed like roaring; in the left, ringing like bells, sometimes like the cackling of geese. A yelling, screeching tone occasionally vibrated through the middle of his head.

The *Mtt* showed no trace of injury: they were gray and dull. There was slight injection around the left malleus, as well as about the anterior-superior segment of the right *Mt*. This condition, however, evidently depended on the recent instillation of various ear lotions.

The treatment from which I had but slight hopes, and which I only undertook at the urgent request of the patient, was fruitless, and, so far as I know, total deafness still persists. I first resorted to vigorous local abstraction of blood, and then to potassium iodide for a long time. In the meanwhile, the constant current was used by Brenner's method (up to 14 Siemen's-Daniell's elements, with  $\frac{3.0}{1.00}$  Siemen's units of resistance), to relieve the subjective sensations of sound. The anode was placed in the meatus, the cathode in the corresponding hand. The following observations were made:

(a) Both ears responded to the exciting currents, *Ca O* and *A O*, with humming or hissing; in the first two sessions in the formula of simple hyperæsthesia.

(b) A violent paradoxical reaction appeared at the first two sittings; *i. e.*, with *Ca O* the permanent humming in the left ear suddenly ceased, and crossed over into the right ear, according to the following formula:

LEFT EAR.		RIGHT EAR NOT ARMED.	
14	elements, 30 <i>Ca S</i> , humming.	—	
14	" 30 <i>Ca D</i> , " continuous.	—	
14	" 30 <i>Ca O</i> , . . . .	humming loud.	
14	" 30 <i>A S</i> , . . . .	"	
14	" 30 <i>A D</i> , . . . .	" continuous	
14	" 30 <i>A O</i> , humming.	—	

The paradoxical humming in the right ear persisted after the session, while the previous subjective noises disappeared for a while.

(c) The favorable influence of the constant current in this case, as in many others, diminished during the later sessions. In the beginning of the treatment the subjective noises would become very faint for fully twenty-four hours, and give rise to delusive hopes. This transitory improvement lessened more and more with subsequent sittings, so that the result of the case fell far below our early *expectations*.

(d) Finally, I would mention, that a humming noise was heard when breaking off conduction from the anode in the neighborhood of 40-30 units, as I have often before observed. It is evident that the current then left the labyrinth, or became so weak that it was like *A O*; on slipping from 30 to 0, no further *A O* reaction was noticed.

The most important point in this case is to decide whether the auditory nerve was excited in the (injured) labyrinth, or further toward the central organ of hearing. The first view presupposes that the nerves of the labyrinth can still be excited by the electric current, when they no longer or but slightly respond to waves of sound.

In conclusion, one or two remarks:

The flow of clear liquid from the patient's nose for two successive days, together with the total deafness which appeared directly after the accident, seems plain enough in a diagnostic point of view. The case is one of those rare ones of recovery from a fracture of the base of the skull.

We should notice particularly that excessive *vertigo* was only present in the three first days, during which period the central organ of the semicircular canals was probably incapable of performing its functions. This observation agrees with the one so often made by other medical men, *that vertigo is not produced by the failure of the semicircular canals to perform their function, but by the active irritation, the shock, which the injury to the canals in question exercises upon the central organ.* (Urbantschitsch, p. 505.)

It has even been proved that exfoliation of the semicir-

cular canals (as well as of the rest of the labyrinth) may take place without symptoms of vertigo, while on the other hand the sudden entrance of air into the middle ear, or the removal, or even the touching, of a granulation lying near the round window, may give rise to the most violent vertigo, and even to (transitory) paralysis of the extremities.<sup>1</sup>

At this point I would mention that Prof. Huguenin thinks that *disturbances in equilibrium are always dependent on a lesion of the vermiform process of the cerebellum.* (*Corresbl. f. Schweiz. Aerzte.*, 1880, p. 717.) "Prof. Huguenin then exhibited a patient, aged 46, in whom a hemorrhage in the cerebellum had been diagnosed. The man was suddenly attacked with vertigo, vomiting, and pain in the occiput. The latter symptom still persists, as well as vertigo, whenever the patient lifts his head. When he walks, he staggers like a drunken man. Pulse 48-56. Prof. H. thought that it was very interesting and new in his experience, that disturbance of the sense of equilibrium could always be referred to a lesion of the vermiform process of the cerebellum. He also explained in the following manner how the removal of the semicircular canals leads to the same variety of disturbances. *Fibres pass from the ganglion cells at the origin of the auditory nerve to the vermiform process, and probably accompany the auditory nerve to the semicircular canals. Other fibres pass with the corpora restiformia from the vermiform process to the medulla spinalis.*"

The *subjective perception of melodies* was only noticed in the early days. Prof. Hermann thinks that this perception is located in the central organ of hearing in the cerebrum.<sup>2</sup> We should, therefore, have to assume, under such a view, that the violent injury of the labyrinth exerted an influence as far as the auditory centre in the cerebrum, where it caused a transitory (two days in our case) irritation.

## II. Concussion of the labyrinth after a blow from a cane

<sup>1</sup> Urbantschitsch, *ubi supra*. Also Brunner: "Auditory Vertigo." These ARCHIVES, vol. ii, part 2, p. 293. These later observations are especially interesting as concerns the relations of the acoustic nerve to the motor tracts.

<sup>2</sup> These ARCHIVES, vol. ix, p. 75.



*in the neighborhood of the ear. Transitory and partial deafness, with pain, for low tones.*

Mr. C., master-locksmith, æt. 59, received on the previous night a severe blow near the left ear from a cane. The locality of the injury is still slightly swollen and discolored. The patient complains of *diminution of hearing, persistent and annoying noises in the ear*, as well as slight pain about the ear and jaw. Vertigo is absent. The subjective sensation of sound, which consisted in the morning of a continuous high tone, has now given way (afternoon) to a deep tone, like that from a church bell.

Examination of the auditory meatus and *Mt*, is negative, with exception of a diffuse opacity in both *Mtt*. The hearing, which had previously been very useful, considering the age and occupation of the patient, is now considerably reduced for both watch and voice, in the left ear. Whispering is not heard on this side, while only an occasional word in a loud conversational tone, close to the ear, can be guessed at, rather than distinctly heard. *W*, left,  $\frac{\text{contact}}{500}$ ; right,  $\frac{6}{500}$  cm. Examination with the piano shows that in the left ear *the four highest notes, e<sup>4</sup>—a<sup>4</sup> can no longer be heard*; notes from e<sup>4</sup> down to f<sup>4</sup> are heard fairly well, while from the middle of the middle octave downward, all the notes cause a sensation of pain in the left ear. *The lower the tones, the more painful the sensation. They also sound dissonant.* The right ear is normal in this respect. The tuning-fork is not heard any louder in the left ear by bone-conduction. The patient recovered in ten days without any other treatment than complete rest.

There is no need of argument to show that this case was not a mere affection of the middle ear. However, the seat of the lesion in the labyrinth, rather than nearer the auditory centres, seems especially indicated by the nature of the injury to which the labyrinth being more exposed was more directly liable. At the same time, this fact takes away all foothold for the view that the irritation of the central organ was conducted along the auditory tracts. It is worthy of mention that the paræsthesia (subjective perception of sounds) and hyperæsthesia affected the same region of the scalp.

It would have been particularly interesting to discover whether this was also the case in the forenoon, *i. e.*, whether

a hyperæsthesia of the high octaves, corresponding to the subjective sensation of high tones, was present in the forenoon, so that *while the hyperæsthesia and paræsthesia fell downward in the scale until afternoon, they were transformed into paresis in the high octaves.*

We are further to note that the upper octaves, which almost invariably suffer the easiest, were also first affected in this case. If we could confirm this condition in other similar cases, we might get additional proof that the upper octaves react most sensitively, not only to vibrations of sound, but to coarse mechanical irritation.<sup>1</sup>

In a similar case observed by Moos,<sup>2</sup> a patient who was struck on the ear with the fist, became for a short time deaf to bass tones.

### III.—*Intrinsic noises in the ear from muscular action.*

*A. Muscular noises in the ear due to mental agitation.*—I lately read in a novel the following passage descriptive of overpowering joy at an unexpected meeting after a long separation: "His heart was too full for utterance, and *there was a noise in his ears like the roaring of waves and the flapping of wings.*" This acute observation on the part of a non-professional writer struck me exceedingly. For the expression, "like the flapping of wings," is a very precise definition (as I can confirm from my own experience) of that entotic noise which is occasionally perceived in moments of great mental agitation, and is undoubtedly due to involuntary and convulsive muscular contractions, accompanied with simultaneous quivering of the facial muscles (angle of the mouth, nostrils). It is a *deep, rough, flapping noise*, just as if the *beating of a large pair of wings* were heard passing by the ear. This beating evidently corresponds in duration to the individual (tetanic) contractions of the muscles concerned, and, as it always seems to me, as if the tubes were opened to the entrance of air isochronously with the beating. I feel obliged to refer the noise chiefly to the tubal

<sup>1</sup> Concussion of the ear by sudden variations of pressure in the air, is also regularly accompanied by a high subjective tone in the ear. See these ARCHIVES, vol. ix, p. 56, *et seq.*

<sup>2</sup> *Virchow's Archiv*, Bd. xxxi, p. 125.

muscles. Perhaps the tensor tymp., or the stapedius also participates, but I have never felt any especial sensation of tension, or movement of the *Mt*, during the noise, so that I must confess that the latter appears too intense to be referred to the tiny stapedius alone. The simultaneous contraction of the facial muscles is also doubtful, because their distance would prevent the production of so loud a noise in the ears.

I would here recall the following obscure case from my own practice:

A delicate girl, æt. 13, suddenly perceived, without any assignable cause, a loud noise in her left ear, "as if a bird were flying by." Deafness in this ear also followed without any other symptoms. When I saw the patient on the next day, her hearing was already restored, and there was nothing abnormal in the ear.

Was this perhaps a case of spasm of the intrinsic or tubal muscles? The flapping character of the entotic roaring, which I regard as pathognomonic, seems to favor such a view. But, on the other hand, how can we explain the deafness, which was indeed of brief duration, but by no means momentary!

More about muscular noises may be found in Herman: *Handbuch der Physiologie*, 1 Bd., 1 Abth., pag. 48, *et seq.* During every voluntary contraction the muscle receives about  $19\frac{1}{2}$  irritations per second from the central organ. Every continuous, at all events every voluntary, muscular contraction is to be regarded as a tetanus. But the audible muscular noise has from 32–36 vibrations per second—contra *C*, contra *D* (Helmholtz). Hence we do not hear the fundamental tone, but the first over-tone of the real muscular noise. Or, as Helmholtz recently assumes, the audible muscular noise has nothing to do with the vibratory period of the muscle, but is a resonating tone of the ear itself, produced by these irregular concussions. In order to hear the muscular noise we should rest our elbows on a table, fix the forefingers firmly in the ears, and then, *e.g.*, contract the thumbs. We at once hear a deep, rattling noise. In my opinion, however, other noises, such as that of the current of blood, and the rubbing produced by the fingers in the meatus, are here at work. This much, at all

events, seems assured, and it is valuable in a diagnostic point of view, that the muscular noise does not rise above contra *d* (37 vibrations).

There are two other intrinsic muscular noises which are to be distinguished from the flapping noise just described.

*B. The well-known cracking (or snapping) tubal noise*, which, as is generally and correctly assumed, originates when the tube is opened by the separation of the adherent walls. Like other persons, I can produce this sound voluntarily, either in the right or left tube, and rhythmically at pleasure, with or without going through with a simultaneous motion of swallowing, *but not without causing the uvula and velum to move rapidly upward*. This noise is short, abrupt, lies in a higher octave than the one previously described, and has another particular characteristic, which depends upon the degree of moisture or adhesiveness of the walls of the tube. Thus, I have noticed in myself that, after the use of the nasal douche, or at the commencement of a nasal catarrh, the noise has a sharper tone, like the tearing of paper. I have also noticed once or twice during a cold that I could not for a while produce the snapping noise in my left ear, the tube of which cannot be easily inflated by Valsalva's experiment. In this case the muscular contraction was not powerful enough to separate the tubal walls.

*C. A hammering, knocking noise in the ear*, which is sometimes perceived in chronic catarrh of the middle ear, and also depends, as I learn from self-observation as well as on others, on muscular action; *i. e.*, on *involuntary* (fibrillar) muscular contractions. This noise, as can often be proved by auscultation, consists of short, muffled beats, like the dull tone of a child's drum, which follow one another very rapidly (faster than the beat of the pulse), and in irregular rhythm. A couple of beats usually follow one another swiftly, in the rhythm of a trochee or dactyl. They sometimes sound like a short firing in file, then comes a pause. The whole is repeated after shorter or longer intervals, but is usually transitory, does not last days or even hours, and bears great resemblance to contractions of the muscles about the eyelids

and face. I think it quite probable that this phenomenon *is also based upon some such fibrillar quivering either of the tubal or intrinsic muscles*, and that it is favored by the chronic affection of the mucous membrane of the muscles, just as tremor of the eyelids is sometimes noticed in chronic blepharitis.

I will not here presume to decide whether these tremulous movements appertain to the intrinsic or tubal muscles. But this much seems evident, that the noise in question is not really a muscular noise, but one indirectly produced by muscular action, similar to the snapping tubal noise. Perhaps it originates in the same way as the latter; *i. e.*, involuntary contractions in the tubal muscles lead to an extremely rapid but slight separation of the tubal walls; or, slight contractions of the intrinsic muscles produce a rubbing noise against the small bones or on the *Mt*.

I call this noise, the *drumming entotic noise*. This term distinguishes it from the real entotic muscular sound, and from the snapping tubal sound. Characteristic of it, together with the above-described peculiarity of its tone, is the fact, that it always appears involuntarily, and that it is repeated several times, but not in the regular rhythm of the pulsating noises. It is not particularly annoying to the patient, and has no special prognostic value.

Under this head we may include the following interesting case; noticing, however, that the noise was extremely annoying, so that not merely slight fibrillar muscular contractions, but more intense clonic spasms were at work.

Madame W., æt. 62, had suffered for many years in her youth with a discharge from her right ear. The left ear was always considered sound. I found that the otorrhœa had stopped, leaving a partial defect of the *Mt*, accompanied with considerable deafness. The left *Mt* was slightly opaque (ot. med. cat. chr.), but the hearing was good considering the patient's age. Right,  $\pi$ ,  $\frac{\text{contact}}{500}$  cm. Left,  $\pi$ ,  $\frac{70}{500}$  cm. She had no trouble at all in hearing conversation.

In March, 1878, the patient suddenly felt, one night without any previous cause, a *sudden knocking noise in the left ear*. It was faster than the pulse, and ceased after half an hour, without af-



fecting the hearing. On the next night, the noise was heard again just like the beat of a drum, and so on for fourteen nights, about half an hour after the patient had gone to bed. The noise often lasted all night long, but sometimes ceased about three in the morning. At daybreak it disappeared. At the end of fourteen days the "beating of drums" changed—at night again—into a "hammering like a mill-clapper," at first slow, then more rapidly, quicker than the pulse, and so violently that the patient became greatly alarmed and lit a lamp. The knocking lasted another six weeks, only at night, with one exception, when it lasted twenty-four hours. The hammering was sometimes interrupted by a noise as if a large bumblebee were flying near the ear. The patient was not aware of other noises, such as whistling, hissing, ringing, or roaring, but sometimes at the beginning of the knocking noise, or while it was present, it seemed as if there were a peculiar drawing sensation from the ear down toward the neck, so that she often asked her husband (who was a physician), whether there was not some connection between the ear and the neck. During this period the patient felt obliged to keep to her bed for five weeks. The physicians declared that the disease was a nervous affection, due to over-exertion at household work. Besides this, the patient had always suffered from a slight trembling or nodding of her head, which still continues.

Eight weeks after its appearance, the knocking ceased as suddenly as it had come on; after beginning in a most violent manner at seven o'clock in the evening, it suddenly disappeared at nine o'clock while the patient was nervously walking to and fro in her chamber, and did not return for four weeks. It then reappeared for eight evenings in succession, but not so violently, nor did it last all night long and then disappear completely. Two months later, after the patient had suddenly lost her husband, the knocking reappeared for four evenings in succession. On the fourth evening, when it was most distressing, it instantaneously disappeared, and up to the last time when I saw the case, three weeks later, it had not again been perceived. I do not know whether or not it has again appeared. *The hearing had not been affected in the slightest degree by these repeated attacks.*

The distinct intermittent character, and, above all, the sudden appearance and cessation of this knocking noise, seem to me to indicate a neurosis. The drawing sensation from the



ear to the throat, so forcibly insisted upon by the patient, would also indicate a clonic spasm of the tensor tymp., or of the tubal muscles. The rapidity of the intermittent contractions reminds one of muscular tremor. Whether the spasm proceeded from the central organ (as seems probable to me), or whether it originated in the periphery, must be left in doubt. The advanced age and nervous disposition of the patient—genuine hysteria was entirely absent—may be suggested as the predisposing causes. In the same way, the simultaneous tremor of the head is to be taken into consideration.

I do not think that this particular noise is really muscular, but that, as in the previous case, it depends upon some movement of the tubal walls, or of the chain of bones, or of the *Mt*, due to the action of the muscles. On the other hand, I am inclined to regard that peculiar sensation “as if a large bumblebee had flown close in front of the ear,” as a muscular noise dependent upon longer contractions, which took place at intervals between the short vibrations.

Hardly any one will agree with the view that the knocking noise was not intrinsic, but dependent on paræsthesia of the auditory nerve or its central organs, although I will not deny that knocking noises, like the beating of a drum, may occur in a purely subjective manner. In the foregoing case, however, there are many symptoms which seem to negative such a view. If I had been able to examine the patient during an attack, an inspection of the *Mt*, or of the soft palate, or orifices of the tubes, might have yielded more satisfactory data.

## ON DISEASES OF THE EAR IN LOCOMOTIVE ENGINEERS AND FIREMEN.

BY DR. D. SCHWABACH AND DR. H. POLLNOW, OF BERLIN.

Translated by JAMES A. SPALDING, M. D., Portland, Maine.

### I.\*

AFTER Moos had read his paper "On the diseases of the ear in locomotive engineers and firemen," etc., before the second International Otological Congress at Milan in 1880 (these ARCHIVES, vol. ix, page 319), it was *unanimously* voted that the Italian Ministry be requested "to send a petition to the various European governments asking the railroad authorities to cause the hearing of these employés to be tested from time to time by competent physicians." As a result of this petition, the Lower Silesian R. R. Co. has lately had the hearing of 160 of its employés at Berlin tested by Drs. Lehfelddt and Pollnow. These two gentlemen discovered 34 men who were more or less deaf, and transferred them to me for a more precise test of their hearing, as well as to determine the objective conditions of their ears, and for eventual treatment. The hearing was tested with a cylinder watch of 1.25 *m.* normal distance, with the common *c*<sup>1</sup> tuning-fork placed on the forehead to test the bone-conduction, and finally with the whispered voice.<sup>1</sup> In some of the cases in which the whispered voice is marked as heard at 6.50 *m.*, the hearing was really higher

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\* Dr. D. Schwabach.

<sup>1</sup> Abbreviations.—*H*, for hearing; *W*, for watch; *T F*, for tuning-fork; *B C*, for bone-conduction; *W V*, for whispered voice.—*Transl.*

than that, but could not be measured further owing to the limited size of the room in which the examination was made.<sup>1</sup>

The results of these tests show, as Moos declared, that *locomotive engineers and firemen, by virtue of their occupation, sooner or later suffer from an affection of the ear, with diminution of hearing, usually on both sides.* The influence of occupation is proved by the fact that *the number of those who are deaf increases according to the length of service.* The percentage of affections of the ear is quite noticeable; in 160 employés we find 34 affected with deafness. From these we exclude one in whom the removal of a plug of cerumen restored the hearing to the normal amount, and so find about 20 per cent. of deafness, which is about the same (25 per cent.) as discovered by Dr. Lent in his examinations for diseases of the respiratory tracts in the same class of employés.

*The number of those affected in hearing during their early years of service is quite small.* Amongst 59 employés who had served about five years, only 5 (8.50 per cent.) were deaf even in a slight degree. *W V* still heard a considerable distance; *W* nearly normal except in two cases in which the hearing was relieved by treatment with the air douche; *B C* generally perfect.

*The number of those who were hard of hearing, as well as the degree of deafness, was much more unfavorable in the case of those employés who had been on locomotive duty for more than five years.* Of the 160 examined, 68 had been employed from six to fifteen years. Of the latter, 14 were deaf (20.5 per cent.).

In some of these cases, hearing for the watch had already diminished *a great deal*. In two cases, both ears, *W*,  $\frac{1}{\infty}$ ; in one case, on one side only, *W*,  $\frac{1}{\infty}$ . In the other cases, *W*, from  $\frac{2}{1\frac{2}{5}}$  cm. to  $\frac{3.0}{1\frac{2}{5}}$  cm. *W V* was still pretty well heard in this series of cases; in the two in which the watch was only heard on contact, hearing for *W V* was decidedly lessened,

<sup>1</sup> The results of this examination are given in a synopsis of the 34 cases, arranged in the form of a table, with supplementary remarks, which are, however, so detailed that they have been omitted from the translation, as it is believed, without essential loss to the reader.—*Ed.*

but greatly improved in one by the repeated application of the air douche. In some cases in which  $W, \frac{2}{12\frac{1}{2}}$  cm. and in one,  $W, \frac{1}{\infty}$ ,  $WV$  could still be heard in one or both ears at 5-6.5 m.  $BC$  for the watch was good in six cases, slight in three, and absent in two. The test was doubtful in three cases.  $TF$  was heard in eleven cases, the same on both sides; in three, louder in one ear, which was always the more defective.

*The defect in hearing, the number of cases, and the degree of deafness increased still more noticeably in those employés of from sixteen to twenty-five years of service.* Of these, 28 were tested and 19 found deaf—35 per cent. In four of these,  $W, \frac{1}{\infty}$  only, viz., two in both ears and two in one ear, while in the other,  $W, \frac{3}{12\frac{1}{2}}$ ;  $W, \frac{3.0}{12\frac{1}{2}}$  cm. Bone-conduction for  $W$  was not perceived in three cases, which we must probably refer to the age of the employés, 50 and 53 years. In three it was weak; in one, only perceived through the temples, and in two the answers were indefinite. In only one was it good through the temples as well as through the mastoid processes.  $TF$  was heard by bone-conduction, in four cases, well in both ears; in one case only, loudest in the better ear, in two, in the more defective ear. *The hearing for the voice was not so much lessened in these ten cases as for the watch.* In only one case was it reduced to contact in one ear, 60 cm. in the other. In all the others,  $WV$  from 30 cm. to 6.50 m., with considerable variations between the two ears.

*The defects in hearing were most noticeable in those employés who had been on locomotive duty for more than twenty-five years.* Of five in this class, four were very deaf (80 per cent.). In one case,  $W, 0$ , both ears, by aërial or bone-conduction;  $TF$  by bone-conduction doubtful. In two cases,  $W, \frac{1}{\infty}$ , but not by bone-conduction, although the fork was still heard by bone-conduction. In one case,  $W$ , on one side,  $\frac{5}{12\frac{1}{2}}$  cm.; on the other, contact. By bone-conduction in this case,  $W$  in the better ear, not heard in the worse ear;  $TF$  the same. These four men were all over 50 years of age, so that an affection of the labyrinth could not be accurately diagnosed from the tests by bone-conduction.

*Three of these four men were also very deaf for the voice.* In one of them only a loud voice could be distinguished close to the ear; in the other ear, a whisper. In another, the hearing was 3 m. on one side, 6.50 m. on the other.

Nine patients complained of *subjective noises*. In one case, in a man only one year in the service, the noises were evidently due to an acute catarrh of the middle ear, and disappeared after Politzer's inflation. The other eight cases occurred in men who had been in service fourteen to twenty-seven years. The roaring had lasted for several years in three cases; in the others it was only transitory.

The subjective noises in one case consisted of a feeling of knocking in the right ear, which diminished whenever pressure was made over the mastoid process, and then gradually disappeared.

The *objective symptoms* in most of the cases consisted in the usual changes in the *Mt*, observed in the sclerosive form of otitis media catarrhalis chronica. Symptoms of chronic pharyngeal catarrh were also occasionally noticed. The latter, in conjunction with nasal catarrh, as is often observed to be the case, seems to indicate a common causal connection between the disease of the middle ear and the catarrhal affection of the nose and pharynx. It is by no means surprising that the duties of locomotive engineers and firemen especially predispose to such catarrhal affections, when we consider their exposure to all sorts and changes of weather, and above all, as Moos suggests, to the action of noxious gases. We can also easily comprehend how the loud noises about the engine, and the shrill tone of the steam-whistle, may cause disturbances of hearing, when we reflect that locksmiths, blacksmiths, and other workmen whose trade exposes them to the influence of loud sounds and noises, often suffer from disturbances of hearing most of which are to be referred to a direct affection of the labyrinth. It seems, therefore, remarkable to me that only three of these cases could presumably be referred to such a cause.

After a violent storm on his regular trip, one man experienced roaring in his right ear, headache, and a feeling of

dizziness. His hearing also soon became affected. The result of the test by bone-conduction was in consonance with these symptoms, for the tuning-fork was heard better in the better ear from all parts of the head, and even from the mastoid process of the worse ear. The excessive degree of deafness with negative condition in the *Mt*, in another case in which the hearing had diminished rapidly in the last two years, indicated a primary affection of the auditory nerve, even if we refer the results of the test of hearing by bone-conduction to the advanced age (57) of the patient. The negative objective symptoms in a third case, in conjunction with the tests of hearing, indicate a primary, although slight, affection of the labyrinth. Moos was unable to demonstrate any *direct* labyrinthine affection in the ten cases which he reported.

We may imagine a secondary affection of the labyrinth from the sclerosive form of ot. med. cat. chron., in six of our cases in which the watch was either not heard at all, or only slightly by bone-conduction. Still, the fact that in all these cases the tuning-fork could still be heard by bone-conduction, would seem to prove that the affection of the labyrinth was but slight.

Although these facts prove without the shadow of a doubt that *disturbances of hearing are very prevalent amongst locomotive engineers and firemen, and that they increase in frequency and intensity in proportion to the years of service*, it must be a matter of surprise that a large number of these employés assured me that they had never noticed any great decrease in hearing, while those who had noticed this decrease for a longer or shorter time declared that it did not in the least incapacitate them for active service. We may indeed place implicit reliance upon what these men said, when we consider that their diminution in hearing generally referred to the perception of fine tones, such as the ticking of a watch, while a whispered voice was heard, in many cases, if not at a normal, at least at a considerable, distance. Thus, in 33 cases, 14 heard *W V* at 6.50 *m.*, 6 in both ears, 7 in one ear; in only 8 cases was *W V* heard at less than 1 *m.*, 3 in both ears, 5 on



one side only. The shrill note of the conductor's whistle was heard by all the employes the whole length of the station platform. These facts lead us now to the question, whether the second of Moos' conclusions, that the disturbances of hearing in locomotive engineers and firemen may endanger the travelling public, is correct or not. In order to determine this question we must first discover what sounds or noises on and outside the engine these employes have to hear in order to insure an accurate performance of their duties.

## II.\*

The following acoustic signals, prescribed by the German railroads, are the ones which we have here to consider.

1. The conductor's signal, by a mouth-whistle, for departure of a train (— —).

2. The signal, by the same whistle, for stopping (U U U).

3 and 4. By the mouth-whistle, or horn, in shifting: "Go ahead" (—), and "Back" (— —).

5. The torpedo-signal (detonating or fulminating signal).

6. The signal of alarm by pulling a rope which is connected with the steam-whistle.

Nos. 1, 3, and 4 are only used when the engine is standing still.

2 is to be used, "when the engineer has just set the train in motion, and it is to be stopped. Further, this signal is to be given during the journey by the employes on the train, to signify danger and to bring the train to a stop."

Signals 5 and 6 are only used when the train is in motion.

If we examine these signals with a view to discovering their importance, so far as concerns security of travel, we see that it is only by a failure to hear those which are prescribed for use while the train is in motion, that danger can arise.

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\* Dr. Pollnow.

In order to test these signals in various ways, I have made repeated journeys on the engine, the first of which was on March 15, 1881, from Berlin to Frankfort-on-the-Oder, by express.

The questions which I wished to answer, were :

1. What can any one with normal hearing hear, when the train is going at full speed ? and,
2. How defective in hearing can any one be, and yet hear signals 5 and 6 ?

The day was calm and sunny, and the upper layers of ground were already free from frost, and once more soft, so that every thing was suitable for hearing sounds of every variety. The engine was a large coupled one with its smoke-stack turned forward. The noise which it made while running was not above the average, as I was informed by the road-master, who made the journey in company with me. We had previously agreed with the conductor that he should, during the trip, give various signals (No. 2) with his whistle from the coupe which he occupied at the rear of the train, and that he should always note the precise time at which they were made. A telegraphic message had also been sent ahead, to lay a torpedo signal on the track.

After the journey had begun, we first noticed that the noise made by the engine was so loud, that even one with perfect hearing could only understand what was spoken when the words were uttered in a loud tone close to his ear ; moreover, that the noise made by the train could not be heard at all. The first extraordinary noise was the detonation of the torpedo signal, of whose presence the fireman and engineer of course knew nothing. The engineer could hear,  $W_{1\frac{5}{8}}$  cm., and  $WV$ ; *Left*, 5 m, *Right*, 6.5 m. But at the instant of the explosion, he cut off steam, and began to stop the engine. After being told, however, that the torpedo signal had only been laid for the sake of experiment, he opened the valves, and the journey proceeded. "I thought that a tire had loosened," said the engineer, evidently more at ease, while at the same time I learned what sort of a noise a loosened tire makes. After a long pause,

during which the attention of both engineer and fireman had been diverted from the next experiment by various remarks, I pulled the signal-cord unexpectedly, and in such a way that the engineer could not possibly see my movements. At the very first shriek of the steam-whistle, the engineer began to stop the train.

The trip was afterward continued to Frankfort without any especial incident.

But where were all the conductor's signals in the meanwhile. The conductor had made a great many, but none of us on the engine (all hearing perfectly, except the engineer) had heard a single one, although we had repeatedly listened for them, and some, as we afterward learned, had been made while the train was running slowly.

On the return trip to Berlin, we had a chance to observe another unusual noise. The buffer, between the engine and tender, got dry, and caused a moderately loud squeaking noise, which was at once perceived by the engineer (*W V*, right, 5 *m*; left, 3 *m*), correctly located, and obviated by oiling at the nearest stopping-place.

The result of our investigations was as follows:

1. The torpedo-signal (or a similar sound, like the breaking of a tire), the steam-whistle signal, and the lesser noise of the dry buffer, were accurately perceived by two engineers whose hearing for slight noises was diminished to  $\frac{1}{25}$  —  $\frac{1}{50}$  respectively, and for whispered voice to about  $\frac{3}{4}$  of the normal amount.

2. No one, even with perfect hearing, can hear the conductor's whistle, or any noise in the rear of the engine, while the train is in motion.

The experiment with the torpedo-signal was afterward tried in the case of others whose hearing was greatly diminished for *W* ( $\frac{5}{125}$  *cm.*). But these employés heard the signal promptly.

Finally, another employé, who heard *W*  $\frac{1}{\infty}$ , *W V* 0.5 *m.* — 2.5 *m.*, was tested with the mouth-whistle. He could hear it very plainly at 60 *m*, and said that the distance could have been doubled without any danger of his not hearing it.

After all, the importance of the mouth-whistle, so far as concerns any danger to traffic or life from any inability on the part of the engineer to hear it, is very trifling, for signals 1 and 2 are either given when the train is standing still, or directly after it has been put in motion. At that time, however, the conductor usually stands close to the engine, and only total deafness could hinder the engineer from hearing them. Our experiments have also shown us the uselessness of signal 2 as a danger signal, a circumstance which is fortunately of no serious importance, because in every train at least the first car must be connected with the steam-whistle by the alarm cord, so that the signal in question (No. 2) would only come into use in case of the very improbable accident of breakage of the cord.

The shifting signals 3 and 4 are always accompanied with the visible hand- or arm-signals. The engineer and shifter never rely upon the audible signals alone, for their trustworthiness is often greatly interfered with by the unfavorable direction of the wind, as well as by the numerous secondary noises about the railroad station.

If we sum up the results of our observations and suppositions, we come to the general conclusion *that no great claims need be made upon the hearing of locomotive engineers or firemen, since even a considerable diminution of hearing in these employés does not endanger the security of railroads.*

Grateful as we may be to Moos for drawing attention to this topic, and interesting as it is in a scientific point of view, to study the influence of the hearing of railroad employés on their capacity for active duty, *the practical value of the subject to the railroad authorities is of but slight importance*, and we may as well coincide with the views of the railroad commissioners:

*That locomotive engineers and firemen hear sufficiently well, so long as they can follow a conversation carried on in the ordinary tone of voice.*

## THE AMERICAN OTOLOGICAL SOCIETY.

THE FOURTEENTH ANNUAL MEETING, HELD IN NEWPORT,  
RHODE ISLAND, JULY 26, 1881.

(REPORTED BY WESLEY M. CARPENTER, M.D.)

### *Morning Session.*

The Society met in the Masonic Building, at 10.30 A. M., and was called to order by the President, Dr. J. Orne Green, of Boston, Mass.

The President appointed as

#### BUSINESS COMMITTEE.

Drs. D. B. St. John Roosa, H. D. Noyes, of New York, and J. S. Prout, of Brooklyn.

The Treasurer's report was read, and referred to Drs. C. J. Blake, of Boston, and C. H. Burnett, of Philadelphia, as

#### AUDITING COMMITTEE.

The following gentlemen were nominated for membership :

Dr. Gorham Bacon, of New York ; proposed by Drs. Samuel Sexton and C. H. Burnett. Dr. Geo. C. Harlan, of Philadelphia ; proposed by Drs. C. H. Burnett and D. B. St. John Roosa. Dr. A. Alt, of St. Louis ; proposed by Drs. John Green and C. J. Kipp. Dr. S. C. Ayres, of Cincinnati ; proposed by Drs. S. Theobald and H. D. Noyes.

*The Committee on Membership* further reported in favor of the election of Drs. W. H. Carmalt, of New Haven, Conn. ; F. B. Loring, of Washington, D. C. ; S. B. St. John, of Hartford, Conn. ; and R. A. Reeve, of Toronto, Can. ; and they were all elected by ballot.

The following gentlemen were made

## MEMBERS BY INVITATION :

Drs. Gorham Bacon and W. M. Carpenter, of New York, and U. H. Brown, of Syracuse, N. Y.

The Business Committee announced as the first paper, one by Dr. S. THEOBALD, of Baltimore, Md., entitled, "Suggestions regarding the treatment of suppurative otitis."

The therapeutic agent to which especial attention was directed consisted of a powder composed of equal parts of boracic acid and oxide of zinc, which he had used freely by insufflation. In some cases he had used boracic acid and alum, and in a very few the oxide of zinc alone. The action of the acid and oxide of zinc was mild and non-irritating, so much so that it could be used in the painful stage of otitis media. Carefully syringe the ear, and introduce the powder freely with an insufflator. Dr. Theobald reported eight cases in which the proposed remedy had been used with marked benefit, and while he did not claim that it was infallible, he recommended it as a valuable combination in the treatment of that class of cases.

In reply to a question by Dr. Blake, of Boston, Dr. Theobald said he thought the powder could be blown into the upper portion of the tympanic cavity.

Dr. H. D. NOYES, of New York, had used with advantage equal parts of tannin and boracic acid, and regarded the combination as much better than either substance, when used alone.

Dr. SAMUEL SEXTON, of New York, had not found the treatment recommended by Dr. Theobald to be satisfactory in acute cases, but in the more chronic cases it had given him satisfactory results, and especially so when combined with calendula, 25 or 50 per cent. He had included the latter because of its repeated healing properties.

Dr. C. J. KIPP, of Newark, N. J., had abstained from using powdered combinations, because he regarded it as good surgery to give vent to accumulations of pus.

Dr. C. H. BURNETT, of Philadelphia, had usually used pure boracic acid, sometimes combined with powdered lysopodium, and with satisfactory results. But he had employed it in only sufficient quantity to cover the walls after cleansing with a syringe, and rather as a dryer in the later stages of muco-purulent affections.



The PRESIDENT had used boracic acid with satisfactory results, especially in dispensary and hospital practice. He had employed it in large quantities, filling the meatus one eighth or one quarter full, because it was so readily soluble that it had not prevented ready flow of the discharge. To be serviceable, it must be in the form of an impalpable powder, and Mawson's pulverized boracic acid was the only reliable article which he had been able to obtain.

Dr. JOHN GREEN, of St. Louis, had used the oxide of zinc extensively, and had come to regard it as a remedy which certainly could be used with positive advantage.

Dr. A. H. BUCK, of New York, directed attention to Reynders' powder-blower as being a very convenient and durable instrument. The tube was so slender that it could be readily introduced into the meatus.

The PRESIDENT had found it to be advantageous to use boracic acid very freely in *profuse otorrhœa*; and he referred to a case of double chronic otorrhœa, in which, within three weeks, the discharge ceased, the large granulations shrivelled, and the progress continued to be favorable without other treatment.

Dr. SEXTON referred to one case in which the discharge was retained, in consequence of packing the meatus with boracic acid. He thought it to be well to caution the patient that upon the slightest continuous pain the ear should be carefully cleansed. He also had frequently seen granulations disappear under the use of this remedy. He preferred to introduce the powder through a speculum, and push it well into the meatus with cotton.

Dr. D. B. ST. JOHN ROOSA, of New York, read a paper on the "Value of operations in which the tympanic membrane is incised," for which see this number of these ARCHIVES.

Dr. C. J. BLAKE, of Boston, favored the small incision, and for some time had used a simple needle. In cases marked by severe pain, considerable congestion at the upper part of the membrana tympani, bulging of the membrane by compressed air, he had made early what might be called a "dry puncture" at the point of greatest prominence; and, in several cases, a sharp hiss had been caused by the escape of the air, the pain had in a measure been relieved, and usually the opening had been utilized within twenty-four hours for free serous discharge with corresponding relief.

Dr. BUCK thought that Dr. Roosa's statement concerning oper-

ations upon the membrana tympani was a very fair one ; and that no single statement could reflect the average sentiment of otologists better than that made. He agreed with it in all essential points.

Dr. C. J. KIPP, of Newark, N. J., fully agreed with the general sentiment expressed by Dr. Roosa. Formerly he performed the operation very frequently, so frequently at least that Dr. Sexton had once referred to his report as evidence of its abuse. Latterly he had resorted to it only in acute cases. In acute inflammation of the middle ear, with scarlet fever, he resorted to the incision only when there was a vascular appearance, with bulging of the membrane.

In the class of cases, called by Dr. Buck inflammation of Shrapnell's membrane, he invariably made an incision, and always with benefit, although the quantity of fluid which escaped might be small.

Dr. H. D. NOYES agreed with the general statement made by Dr. Roosa. He preferred, however, to make a free opening in acute cases, because of the tendency on the part of the membrane to rapid closure, and thus prevent a suitable escape of the fluid. He had performed the operation almost exclusively in acute cases ; and in order to make the incision with accuracy, a mirror should be used.

With reference to aural inflammation with scarlet fever, he had reached nearly the same opinion as that expressed by Dr. Kipp. If there was a great deal of pain, considerable resistance of the membrane, with or without bulging, he had found it to be advantageous to make a free incision. On the other hand, in cases in which ulceration occurred rapidly, and speedy egress would be afforded to the fluid by natural processes, an incision was detrimental.

Dr. J. S. PROUT, of Brooklyn, several years ago attempted to make a permanent opening in the drum-head, in a case of chronic non-suppurating inflammation, and in that case the improvement in hearing was very marked for some months, but gradually the opening closed, and finally the hearing was no better than if the operation had not been performed.

In a second case he performed the same operation, and the result was a permanent suppurative inflammation ; and in view of that result he had not attempted to apply the method of treatment since.

In the acute inflammatory conditions, when there was accumulation of fluid, bulging of the membrane, and the case was especially painful, he made an incision in the drum-head.

Dr. C. H. BURNETT heartily subscribed to what Dr. Roosa had formulated; but would add that he always incised when he thought there was any fluid behind the membrane. The gentleness of the operation he regarded as very important; and his custom had been to simply stab the membrane first, making the smallest possible opening, and if then the fluid did not flow freely, the puncture could be slightly enlarged. He also thought, with Dr. Prout, that it was not wise to wait too long, for dangerous results might follow, and besides there was advantage in having the surgeon select the position for the opening.

Dr. SEXTON remarked that he had not had any experience in operations upon the drum-head for improving impaired sense of hearing. He had not, moreover, been in the habit of frequently perforating the membrana tympani for the liberation of fluids. He did not regard the mere existence of fluid, either serous or purulent, in the tympanic cavity as a condition always calling for perforation of the membrane. If he was to be guided by any single condition, he would say that if the membrane was upon the point of giving way from ulceration, he should not wait, but neither bulging of the membrane, nor the neuralgic pains, which are so frequent a symptom in these acute cases, would necessarily induce him to operate, for he believed that extension of the inflammation to the brain depended more upon continuity of structure than upon the presence of fluids in the tympanum. He had been in the habit of prescribing internal remedies for the relief of the inflammatory process, and the one mostly relied upon perhaps was the sulphide of calcium, in doses of from  $\frac{1}{10}$  to  $\frac{1}{2}$  a grain. For the relief of pain, he did not rely entirely upon the calcium, but gave in addition some preparation of aconite in small doses frequently repeated. The use of leeches he had long since discarded.

Dr. NOYES said that in performing the operation in acute cases he always used an anæsthetic; ether in the young subject, and in the adult patient either ether or chloroform, administered only sufficiently to produce primary anæsthesia.

Dr. PROUT said that when Dr. Matthewson, nine years ago, incised the drum-head in one of his ears, he did not find it to be so painful as he had anticipated. Blood and mucus escaped, and he was certain that it would not have been so well to have waited.

Dr. NOYES remarked that he incised the drum-head in one of Prof. B's ears, and the doctor said that he would not submit to the operation again without an anæsthetic.

Dr. E. W. BARTLETT, of Milwaukee, Wis., assented to the general statement made by Dr. Roosa. The only operation which he performed was paracentesis, and, if the knife was well-pointed and perfectly sharp, so that it would pass through kid without pricking at all, it was painless. He thought that it was safer to make the opening too early than too late, and if left to be made by nature it was apt to be in the wrong place.

Dr. BLAKE had not used anæsthetics in this operation.

Dr. BUCK had used anæsthetics only very rarely when performing the operation upon adults, and could not recall a case occurring in children from one to three years in which he had found them necessary.

Dr. A. MATTHEWSON, of Brooklyn, had not had a favorable experience in operating upon the drum-head in non-suppurating cases. In the acute suppurative affection, if the pain did not subside within a short time, he resorted to puncture of the membrane.

Dr. BURNETT had not employed anæsthetics. In acute cases his patients had not complained of pain from the operation, but in some of the cases of so-called chronic catarrh, incision of the drum-head had given rise to considerable pain.

The PRESIDENT remarked that the testimony seemed to be so universally in favor of incising or puncturing the drum-head in acute cases of accumulation of fluid within the tympanic cavity, he would ask if any one favored the older operations, which Dr. Roosa had condemned in chronic non-suppurative affections.

Dr. THEOBALD agreed with the general inadvisability of incising the drum-head except for the purpose of promoting the escape of some accumulation. In many cases of chronic inflammation in which there was fluid in the tympanic cavity, the accumulation could be gotten rid of without making an incision; and in such cases he thought that the catheter was more useful than Politzer's method.

To check the inflammation in acute cases he recommended instillations, three or four times a day, of a solution of atropia; four grains to the ounce of water.

Dr. BUCK thought all present were so perfectly in accord with the general statement made by Dr. Roosa concerning the cutting

of tendons, opening the membrane with acids, etc., that no one could wish to prolong the discussion.

Dr. D. B. ST. JOHN ROOSA, of New York, then read a paper on "The tuning-fork in diagnosis."

The following propositions were laid down as having been verified by the author's practice:

1. If one ear be normal as to hearing power, and the other abnormal, and a vibrating tuning-fork be placed upon the vertex or the teeth, if its sound be intensified in the ear whose hearing power is diminished, there is disease of the external or middle ear, but no lesion of the labyrinth or nerve.

2. If, under the same conditions of a sound ear on one side, while the hearing power of the other is impaired, the tuning-fork be not heard better in the worse ear, even if the meatus be stopped by the finger or the like, there is disease of the labyrinth, the acoustic nerve, or brain.

3. If the vibrating tuning-fork be heard better on the mastoid than when placed in front of the meatus, there is disease predominantly of the middle ear.

4. If the tuning-fork be heard better through the air than through the bones, there being impairment of hearing, the disease which gives rise to this symptom is situated in the brain, nerve, or labyrinth.

Dr. BLAKE, of Boston, had found it necessary to use a number of tuning-forks of different letters for purposes of testing; for, in some cases the patient did not hear one tone while he might hear another.

Dr. ROOSA's second proposition brought up the question of conduction of vibration through fluids, which was the particular question in view in a series of experiments which he had not yet completed. But the results of the experiments, so far, went to show that a considerable impairment attended the transmission of vibrations through fluid in a solid or closed space. It was therefore possible to imagine a condition in which as the result of intra-labyrinthian pressure, the vibrations of the organ of Corti would be impaired.

Dr. JOHN GREEN, of St. Louis, suggested that the head was a positive resonator, and that the power of conduction varied in the heads of different patients.

Dr. BLAKE said that from experiments made by himself six

years ago, he could say that there was very nearly an octave difference in the resonant power of the mastoid cavity in man. In different animals there was also a marked difference.

The President, Dr. J. ORNE GREEN, of Boston, then read a paper, entitled "Removal of a foreign body by disarticulation of the auricle."

A pistol had been fired into the ear on the 11th, and the patient died on the 23d of the same month. The bullet was removed early, and in the manner indicated, and was in three pieces. Dr. Green commented upon the criticism of the operation made by Dr. S. D. Gross, of Philadelphia, who had performed the same operation, and he was surprised at Dr. Gross' criticism.

Dr. ROOSA stated that he, like Dr. Green, was surprised to read, years ago, the statement by Professor Gross, that the suggestion of an operation for detachment of the auricle was absurd, and a recent remark by a reviewer in the *American Journal of Otology* somewhat to the same effect. He had performed the operation some years ago, in a case in which he was assisted by Dr. Rankin, of Newport, and in Dr. Ely's case of operation for deformity of the auricles (see these ARCHIVES, vol. x, p. 97) he had also found the operation entirely feasible, and that it afforded a good view of the tympanic cavity.

The Society adjourned to meet at 4 P.M.

#### *Afternoon Session.*

The Society was called to order at 4 P.M. by the President, and the minutes of the previous session were read and approved.

The first paper was read by Dr. C. H. BURNETT, of Philadelphia, and entitled "Malignant growth in the naso-pharynx, with early aural symptoms."

The aural symptoms were due to obstruction of the pharyngeal extremities of the Eustachian tubes. Both drum cavities filled twice with fluid. No autopsy could be obtained.

Dr. ROOSA asked Dr. Burnett if he thought that the improper use of the Turkish baths mentioned in the clinical history was what led to the development of the primary disease.

Dr. BURNETT replied that there was a connection between the two in point of time, and the patient, an intelligent physician, believed that the relation was one of cause and effect. Dr. Burnett's own opinion was that Turkish baths, improperly used, might give rise to naso-pharyngeal catarrh.



Dr. ROOSA remarked that he has recommended such baths for patients who were constantly taking cold, but has not seen much benefit from the remedy.

Dr. C. J. KIPP, of Newark, N. J., then read a paper containing the history of a case of "Epithelioma of the middle ear." See this number of these ARCHIVES.

"Selection of test-words according to their logographic value," was the title of an oral communication made by Dr. C. J. BLAKE, of Boston, who had been experimenting with the view to obtaining as accurate a means as possible for testing hearing. Search for any single method or instrument, however, was like the search for the philosopher's stone. The object of his experiments had been to arrange consonant sounds according to their force value, according to the intensity of tone produced by the amount of air expelled, and he had found that those in the English language could be classified and arranged quite readily into words which would represent intensity of tone. For example, the word *cat* could be heard by the greatest number of persons; the word *house* by 40, and the word *hand* by 56 per cent., etc. A large variety of words was most important, and he had made a list sufficiently extensive so that different selections could be made upon each occasion of testing.

It was discussed by Dr. Burnett.

Dr. A. H. BUCK, of New York, then read a paper entitled, "Sudden and complete loss of hearing during an attack of mumps."

The paper contained the histories of two cases, with remarks. The first was that of a girl who on the third day of an attack of mumps had sharp pain in the ears, and on the following day she discovered that she had lost the power of hearing. The second case was that of a man in whom deafness developed without pain during an attack of mumps. In both cases each parotid region was equally affected, but in one only one ear was involved. Dr. Buck believed that the origin of the deafness was in the labyrinth in both these cases. (The paper may be found in the *American Journal of Otolology*, vol. iii, p. 209.)

Dr. ROOSA remarked that he had seen sufficient of such cases to make him anxious that no one in whom he was interested should get the mumps and then get ear trouble. He had seen the second case reported by Dr. Buck, and concluded that the nerve was in a

state of inflammation and that atrophy of its fibres would follow. He hoped that Dr. Buck would remove his book from the category in which he had placed it, as giving no account of deafness from mumps. Parotitis as a cause of disease of the ear had been mentioned in his first edition, while in the later ones the subject was quite fully discussed. He would be glad to have his colleague, Dr. Sexton, who had but little faith in the existence of disease of the acoustic nerve, give the situation of the lesion that produced the deafness thus suddenly developed in the course of an attack of mumps.

Dr. SEXTON was much obliged to his colleague for his kind invitation, but thought that so far as theories went he must give to him the palm. Not having had the opportunity to examine the cases reported by Dr. Buck, he did not feel qualified to give an opinion concerning them. However, he was willing to abide by the diagnosis made and the opinions expressed by both Dr. Buck and Dr. Roosa.

Dr. BURNETT asked for the evidence of the labyrinthian disease.

Dr. BUCK replied that Vogel's statement had led him to that conclusion. It was evident that the auditory nerve was affected; whether in the labyrinth, or in the cranial cavity, or in the medulla oblongata, he would not be positive; but, with such anatomical relations as existed, it would be natural to assume that the inflammatory trouble existed in the cochlea or labyrinth rather than in more remote regions.

Dr. BURNETT's experience had led him to the conclusion that the lesion in this class of cases was, in the middle ear, catarrhal in character and produced by congestion about the parotid gland.

The PRESIDENT had been satisfied, for a number of years, that in a certain percentage of cases, middle-ear changes developed after labyrinthian trouble had existed for some time.

Dr. ROOSA remarked that he had already alluded to that point in discussing deafness caused by cerebro-spinal meningitis. He had seen cases in which there were no changes, appreciable by him, in the drum-head, and yet the deafness was absolute, but with the lapse of time came changes affecting the membrana tympani, which were marked. He thought that slight injustice was being done to the subject by not investigating the labyrinth as ophthalmologists did the retina and the optic nerve, and he be-

lieved that in the light of recent investigations such as those of Moos and Steinbrügge, it would soon be possible to diagnosticate acoustic neuritis and atrophy.

Dr. KIPP thought the fact was often overlooked that a great many cases existed in which hearing was perfect, and yet the drum-head presented morbid appearances. Besides, we should reason somewhat from analogy; there were but few cases of acute inflammation of the middle ear in which deafness was developed with such rapidity as had been mentioned.

Dr. BURNETT said that he had had opportunity to examine a very large number of cases of deafness following cerebro-spinal meningitis, and was certain that in very many of them the drum-heads were in good condition, notwithstanding the deafness was of long standing.

The PRESIDENT said that he did not wish to have any general conclusion drawn from his statement, as it was meant to be simply that, in some cases at least, secondary changes involving the tympanic cavity followed labyrinthian disease.

The paper was further discussed by Drs. John Green, Prout, Kipp, Roosa, and Sexton.

Dr. BUCK, of New York, then read a brief paper containing the history of a case of "Small vascular tumor of the membrana tympani." He regarded the occurrence of such tumors in that region as very rare.

Dr. SAMUEL SEXTON, of New York, exhibited "A flexible Eustachian catheter."

(For a complete description of the instrument with illustrations, see the *Medical Record*, vol. xx, p. 82.)

The Business Committee reported the following

#### NOMINATIONS FOR OFFICERS

for the ensuing year :

*For President*, Dr. J. Orne Green, of Boston.

*For Vice-President*, Dr. J. S. Prout, of Brooklyn.

*For Secretary and Treasurer*, Dr. J. J. B. Vermyme, of New Bedford.

*For Committee on Publication*, Drs. J. J. B. Vermyme, C. J. Blake, and J. Orne Green.

*For Committee on Membership*, Drs. John Green, of St. Louis ;

C. H. Burnett, of Philadelphia ; and H. G. Miller, of Providence.

The report of the Committee was unanimously adopted.

The Society then adjourned to meet at 10.30 A. M. on the day previous to the first day of the annual meeting of the American Ophthalmological Society, in 1882, and in the same place.

# REPORT ON THE PROGRESS OF OTOLOGY FOR THE FIRST HALF OF THE YEAR 1881.

Translated by ISIDOR FURST, of New York.

## I.—NORMAL AND PATHOLOGICAL ANATOMY OF THE ORGAN OF HEARING.

By H. STEINBRÜGGE, OF HEIDELBERG.

1. CHARLES J. KIPP. On branchial fistulæ at the external ear. *Transact. Amer. Otological Society*, 1880.
2. J. ORNE GREEN. The foramina of the mastoid emissary veins. *Amer. Jour. of Otol.*, vol. iii, No. 2, April, 1881.
3. C. HASSE. Bemerkungen über die Lymphbahnen des inneren Ohres. [Remarks on the lymph-channels of the internal ear.] *Arch. f. Ohrenheilk.*, Bd. 17, H. 3.
4. CH. SEDGWICH MINOT. Some recent investigations of the histology of the scala media cochleæ. *Amer. Journ. of Otol.*, vol. iii, No. 2.
5. L. KATZ, of Berlin. Zur Casuistik des Cholesteatoms des Schläfenbeins. Tod durch Sinusthrombose. [Cholesteatoma of the temporal bone. Death by thrombosis of the sinus.] *Berlin. klin. Wochenschr.*, No. 12, 1881.
6. JAMES A. ADAMS. On certain anatomical relations between abscess of the brain and aural disease. *Glasgow Med. Journ.*, vol. xv, No. 6, June, 1881.

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1. KIPP observed in 6 persons (4 males, 2 females) at the helix, about 1 cm. above the upper margin of the tragus, fistula-like channels, 3 to 10 mm. in length, which secreted a milky fluid. In three the anomaly existed on both sides, and in a like number

the channel terminated in a cyst. No other malformations were connected therewith. In all cases the anomaly had existed from birth. Two cases occurred in sisters, but no other heredity could be demonstrated. By retention of the contents, the cysts enlarged, and could be reduced only after repeated incision and application of caustics.

2. ORNE GREEN examined in 16 skulls the mastoid foramina, in respect to their presence, size, and position. They were present 29 times, varied in diameter between 5 and 0.5 *mm.*, occurred regularly at the posterior limit of the mastoid process, but at variable height, namely, 20 times in a line drawn from the external auditory meatus above the centre of the mastoid process, twice above, six times below it, and once at the base of the skull.

3. HASSE confirms the fact regarding the endolymphatic spaces, that the aquæductus vestibuli in man and mammals ends in a cul-de-sac in the dura mater, and conjectures that its communication with the subarachnoid space takes place solely by means of the arachnoidal sheaths enveloping the nerves and vessels; that a renewal of the endolymph can occur besides by diffusion from the epi- or endural serous channels. The perilymphatic spaces communicate in part by means of the dura sheath of the acoustic nerve with the subdural cavity; the main efferent channel for the perilymph, however, is formed by the aqueduct of the cochlea. The latter is said not to lead into the subdural space; the author supposes, basing on his examinations of the labyrinth in the four lower classes of vertebrates, that, besides the dura investiture, it contains a membranous canal which connects both with the subarachnoid space and with a lymphatic vessel accompanying the jugular vein.

4. The present communications contain the results of Böttcher's histo-genetic investigations of the labyrinth from the year 1869, as well as those of Lavdowsky's examinations of the acoustic terminal apparatus of mammals, published in 1876 in the *Archiv für microscopische Anatomie*, and therefore contain nothing new to the reader.

5. The author reports three cases of cholesteatoma of the petrous bone.

(1.) A man, æt. 22, suffering from bilateral chronic otitis media purulenta. Right fistulous tract in the mastoid process. Daily rigors; icterus; after six days, death, with symptoms of sepsis.



*Autopsy:* Multiple pulmonary abscesses, tumor of the spleen, in the right transverse sinus thrombi which extend into the jugular vein as far as the middle of the neck. Fistulous tract leading from the posterior wall of the auditory meatus into the mastoid antrum; the latter dilated, with smooth walls, and filled with masses of cholesteatoma. Perforation the size of a bean at the posterior surface of the pyramid. Communication of the fistulous tract in the mastoid process with the sigmoid fossa. The ordinary microscopic appearances. At the places exposed to the air, the tumorous masses were pigmented by numerous yellow round bodies.

(2.) A boy, æt. 13, with caries of the left mastoid process. Incision above it, on account of great œdematous swelling. Death after three days from septicæmia. Cholesteatoma of the mastoid process, and of the drum cavity. Perforation at the posterior surface of the petrous bone. Sinus thrombosis and basilar meningitis. Narrowing of the left auditory canal.

(3.) A man, æt. 30, suffering from otorrhœa of the right side. Granulation in the auditory meatus, fistula at its posterior wall, drum destroyed. Paralysis of the right facial. Agonizing pain, vertigo, sopor. Under ice applications, improvement in the course of four weeks. Complete deafness, right; paralysis of the facial has disappeared. Nine months later, death from right pleuritis, starting from caries of the lower ribs. Right temporal bone carious, and filled with masses of cholesteatoma. *No traces of any preceding affection in the brain and dura mater.* The author holds, therefore, that the former threatening symptoms were due to an inflammation of the labyrinthine structures.

6. The author endeavors to prove that although purulent otitis media is more frequent in childhood than in adult age, cerebral abscesses due to the aural affection are more common in the latter. The causes are ascribed to anatomical conditions, and the author regarding the veins as the exclusive channels for the conduction of septic materials, his corollary is briefly the following: In the child the cells of the mastoid process are less developed than in the adult; the mastoideo-squamous suture, however, is still open, hence any pus possibly present is more usually evacuated externally. On the other hand, in the adult, the suture is closed, but the wall separating the mastoid cells from the transverse sinus is thin, and thus morbid processes are here more easily transferred to the vessel-walls of the sinus. In this way thrombi

are produced, which again cause stasis in the other sinuses, especially in the sinus petrosus superioris. The cerebral veins have no valves; the blood-current is, therefore, reversed, thus facilitating the conduction of septic matter from the petrous bone to the brain. Small veins extending from the dura directly into the brain substance of the occipital lobes and the cerebellum, effect this transference.

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## II.—PHYSIOLOGY OF THE ORGAN OF HEARING AND PHYSIOLOGICAL ACOUSTICS.

BY OSCAR WOLF,\* OF FRANKFORT-ON-THE-MAIN.

1. BENNO BAGINSKY, Berlin. Ueber die Folgen von Drucksteigerung in der Paukenhöhle, und die Function der Bogengänge. [On the consequences of increased pressure in the drum cavity, and the function of the semicircular canals.] *Archiv für Anatomie und Physiologie*, by His, Braune, and Du Bois-Reymond. Physiological Department, 1881, Heft 3, 35 pp.

2. VICTOR URBANTSCHITSCH, Vienna. Zur Lehre von der Schallempfindung. [The perception of sound.]

3. DENNERT, Berlin. Zur Analyse des Gehörorgans durch Töne in ihrer Bedeutung für dasselbe. [The analysis of the organ of hearing by tones in their importance thereto.] *Berliner klin. Wochenschr.*, 1881, No. 18. Reprint, 22 pp.

4. EUGEN BLEULER and KARL LEHMANN. Zwangsmässige Lichtempfindungen durch Schall und verwandte Erscheinungen auf dem Gebiete der anderen Sinnesempfindungen. [Sensations of light induced by sound, and kindred phenomena in the other organs of special sense.]

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1. BAGINSKY was incited to the present investigations by observing a dog, which for several months had exhibited distortion of the head and vertigo. Dissection of the animal had shown that the drum cavity of the affected side was tensely filled with watery fluid. In the labyrinth and in the brain no coarser, microscopically visible lesions could be found.

For the purpose of *increasing the pressure*, injections of different liquids of varying temperature were made into the *drum cavity*, after perforation of the membrana tympani, of the animals experi-

mented upon. The author remarks *a priori* that during such injections fluids easily escape into the trachea through the tubes, thus exposing the animals to the danger of asphyxia; therefore, "the trachea must be compressed or tracheotomy performed previously." The reporter cannot refrain from expressing some disapprobation of such utilization of the results of the dissection. An animal whose trachea is compressed is at any rate in a state of cerebral hyperæmia; moreover, even tracheotomy does not in the least prevent the flow of liquids into the bronchi when fluids are forcibly driven through the tubes into the naso-pharyngeal space. As the author does not state anything about the *post-mortem* appearance of the lungs, simply remarking that tracheotomized animals die early, pneumonia or asphyxia is not excluded as cause of death. It is well known that in dissections of that nature the brain and meninges are often found hyperæmic and œdematous.

As regards the observations, the animals experimented upon showed nystagmus and turning of the head (toward the side operated upon); these symptoms were more pronounced after the injection of cold or chemically different liquids than after that of warm or chemically indifferent fluids. The forcing of air under great pressure through the tubes was likewise followed by rolling of the eyes, nystagmus, exophthalmus, and, finally, death. The author explains the entrance of fluids or air-bubbles into the subdural space by the tearing of the membranes of the fenestræ, after which the fluid reached the arachnoid space by way of the aquæductus cochleæ.

Moreover, to disprove the doctrine formulated by Goltz, according to which the semicircular canals should be considered to some extent as peripheral organs of the so-called static sense (Breuer), Baginsky destroyed the respective parts of the labyrinth in dogs and pigeons, and reaches the conclusion "*that an isolated injury of the semicircular canals without a reflex effect on the brain is impossible*," and that, therefore, the succeeding disturbances of equilibrium must be referred to cerebral lesions (extravasations of blood, draining away of cerebro-spinal fluid, purulent meningitis). Unfortunately the reporter cannot coincide with this deduction of the author. For, on the one hand, Baginsky's own statement—that, after section of the horizontal canals, a horizontal, after division of the posterior vertical canals, a vertical pendulousness of the head occurred—still speaks strongly *in favor* of Goltz's doctrine; on the other hand, Spamer,<sup>1</sup> who divided his experiments, for the pur-

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<sup>1</sup> Compare the reference in these ARCHIVES.

pose of demonstrating the result, into "*pure*" (such cases in which no kind of cerebral lesion was found at the autopsy) and "*imperfect*" ones, has furnished the proof that it is certainly possible to experiment with the semicircular canals without causing cerebral lesions. Spamer attaches but little importance to the invariably minimal escape of cerebro-spinal fluid through the vestibular aqueduct, as it occurs only exceptionally and can produce nothing but quite transient symptoms. Moreover, Spamer found that the simple isolated irritation of a semicircular canal produced symptoms of vertigo and nystagmus. Finally, the reporter is of opinion that the "pathological experience" (according to which, despite necrotic separation or total degeneration of the entire labyrinth, no symptoms of vertigo or disturbances of equilibrium occurred unless the brain suffered at the same time) cannot be cited at all in proof; for the destruction by gradual degeneration of the peripheral organ of the so-called static sense produces attacks of vertigo much more rarely, according to universal experience, than the *irritation of the functionally active sense*. Spamer has also proved, experimentally, "that the majority and the most prominent of the motor disturbances occurring after injuries to the canals must be interpreted as symptoms of irritation." In numerous cases the reporter has observed that patients with diseased labyrinths suffered from severe attacks of vertigo at the beginning of the affection, and that these disturbances of equilibrium disappeared completely with the increasing degeneration of the organ.

2. URBANTSCHITSCH, in the present treatise, makes some very interesting communications regarding fatigue of the ear, the localization of the acoustic image, and acoustic after-sensations—questions which have hitherto not received the attention of physiologists which they deserved.

After mentioning previous experiments by Dove<sup>1</sup> and J. J. Müller,<sup>2</sup> the author first reports those of his investigations which refer to fatigue of the ear. For these he employed two rubber tubes which were inserted into both ears, and the free ends of which were held close together. His sources of sound were large tuning-forks vibrating slowly. To determine the auditory function of each ear, he conducted the diminishing tone of the fork to the two ears, provided each with an ear-tube, in rapid succession;

<sup>1</sup> Dove, Poggendorff's *Annalen*, 1857, Bd. 101, p. 492; 1859, Bd. 107, p. 653.

<sup>2</sup> J. J. Müller, *Arbeiten a. d. phys. Anstalt zu Leipzig*, mitgetheilt durch Ludwig. Leipzig, 1872, p. 1.

in case the tone faded away more quickly in one ear than in the other, the tube of the better-perceiving ear was removed so far from the source of sound, or the conduction of sound so much weakened by pressure on the tube, that the tone of the tuning-fork became inaudible in both ears at the same time. Then a tuning-fork was struck sharply and held to the free end of one of the tubes, so that that particular ear alone perceived the sound; after ten to fifteen seconds the tuning-fork was quickly dampened by putting a finger to the prongs in such a manner that the tone was just barely audible. As soon as it had completely died away, he rapidly approached the tuning-fork to the tube of the other ear thus far excluded from the test. Thus it was found that the tone of the tuning-fork, which had already become inaudible to the fatigued ear, was still clearly perceptible for several seconds to the non-fatigued ear. In a parallel experiment, in which the rôles of the two ears were reversed, the same phenomenon was apparent. Urbantschitsch had, moreover, made the experiment in such a manner as to rapidly move the greatly dampened tuning-fork, after preceding fatigue of the ear, to and fro between the ends of the two otoscopes. This test-method makes it possible to observe more clearly the difference in the perceptive power of the two ears even before the rapid disappearance of the tone in the fatigued ear.

The fatigue of the ear for the test-tone having been determined by means of the procedure just described, the author endeavored to investigate the behavior of an ear fatigued for one tone, toward another very faint tuning-fork tone.

The experiments at first were conducted only with such individuals as perceived equally well with either ear both a high-tone and a low-tone tuning-fork employed for the test. Urbantschitsch fatigued one ear of such an individual with one of the tuning-fork tones, then removed it and tested immediately afterward the perceptive capacity of both ears with the other very faint tone. The tests yielded no difference of hearing between the right and left ear, but the second tone was perceived as of equal intensity on both sides, and died away at the same time in both ears. This observation, then, is in favor of the assumption that the fatigue of the ear is limited only to that tone or group of tones to which it had been exposed; while the perceptive capacity of the ear for other tones suffers no diminution, at least to an extent demonstrable by the test-methods employed by Urbantschitsch. This



fact becomes very conspicuous if one ear be vigorously acted upon by a high, the other by a low tuning-fork tone; the forks then be quickly dampened, and the moment the respective tone has ceased at either ear, the position of the two tuning-forks be reversed. It then becomes evident that the ear which no longer heard the high tone still plainly perceived the low tone; while again, the other ear, fatigued for the low tone, recognizes the high tone surprisingly well.

Further experiments referred to the *duration of the fatigue*.

To this end, Urbantschitsch allowed the tone of a large tuning-fork to act vigorously on the ear, then quickly dampened it as in the above-described experiments, but kept the fork immovable after it had become inaudible, in order to ascertain if the tone would again become perceptible or not, after a while. It was found that the tone which had been inaudible, indeed reappeared, usually after two to five seconds, was heard for several seconds more, and then died away. In a comparative test of the sound-perception of both ears, the tone returning in the fatigued ear appears as of equal intensity with the other ear, and fades away at the same time on both sides. This shows that an ear fatigued in the above manner recovers completely after the lapse of a few seconds, and perceives again as fully as before the fatigue, or as the other non-fatigued ear.

For the determination of the *localization of the acoustic image*, or, as Urbantschitsch terms it, "*the subjective acoustic field*," he employed a T-shaped conducting tube, the two equally long arms of which were introduced into both auditory-canals, while the third arm served as sound-receiver. The reported results of the experiments show that the differing statements regarding the localization of the subjective acoustic field by Purkyně and S. Thompson, on the one hand (relegating the tone conducted by two receiving telephones into the occiput), and those of Plumaudon,<sup>1</sup> on the other (who places the image into the frontal region), do not contradict each other, but must be referred partly to individual differences, partly to the tones used in the test. For Urbantschitsch found that the various tones were localized in different parts of the head, and that one person tested placed the acoustic field farther forward, another farther back.

The subjective acoustic field in those with normal hearing mostly moved in the medial line of the head, but suffered a lateral

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<sup>1</sup> Comp. these ARCHIVES.



displacement whenever one ear was fatigued sooner than the other, and of course toward the non-fatigued side.

The reporter is less inclined to coincide with the remark of the author that *no so-called field of combination* occurs in simultaneous conduction of two tones of different pitch. It appears the author has experimented with tuning-forks only. The reporter is convinced, were the author to extend his experiments to the apparatus for over-tones, that the combination tone will become apparent.

"*As regards the positive acoustic after-images,*" in the sense of the optical after-images, nothing was known heretofore but the ones (above-mentioned) resting upon fatigue, *i. e.*, the after-sensations corresponding to the negative optical after-images. We must be careful not to mistake "the memory-images of the senses" (Fechner) for the positive acoustic after-sensations. Urbantschitsch in his experiments found, especially in those with defective, but also in those with normal hearing, that there occur *primary* (*i. e.*, immediately following the preceding objective tone) and *secondary* (succeeding the objective tone after a pause) acoustic after-images.

Generally an after-image persists for from five to ten seconds. It may be mentioned that the positive acoustic after-images can be most easily produced in female and in young male individuals; middle-aged men are but little qualified for the test. In order to prove that they were not "memory-images," the author makes mention of a patient who possessed, in a high degree, the faculty of recalling to mind any musical tone at will. Urbantschitsch first conducted a very high tone into the normal ear of this man. No acoustic after-sensation occurred. He then allowed the tuning-fork to act on the left, very badly hearing ear, and invariably after ten to twenty seconds an exceedingly distinct, quickly evanescent after-sensation ensued.

3. In the introduction to his treatise, DENNERT gives a very clear and lucid historical synopsis of the various methods of analytical tests of hearing, the first instigation to the discovery of which was given by Helmholtz's "*Lehre von den Tonempfindungen.*"

The author himself employs for the test, along with Politzer's acoumeter, speech-sounds according to the reporter's method, a series of tuning-forks, namely, capital C, which can be lowered to contra-G by König's disks, also small c, c<sup>I</sup>, c<sup>II</sup>, c<sup>III</sup>, c<sup>IV</sup>, c<sup>V</sup>,<sup>1</sup> and

<sup>1</sup> The reporter thinks it more advantageous to employ smaller intervals than octaves, and the a<sup>1</sup> cannot well be dispensed with, especially for musical patients. The reporter would advise the following forks: C, with eventual lowering to contra-A, also c, g, c<sup>I</sup>, a<sup>1</sup>, c<sup>II</sup>, g<sup>III</sup>, c<sup>V</sup>.

of König's steel-rods the  $g^{VI}$ , so that he can test within a range of nine octaves, or from 49.5 to 12,000 (single) vibrations. He confirms the experience that if high and low tones are produced under the same conditions and by the application of equal mechanical contrivances, the high tones produce an extraordinarily greater sensation than the low ones; his investigation also proved that the reduced hearing power for *speech* does *not* rise and fall proportionately with the reduced hearing-power for *tones* ("tuning-fork tones" are probably meant.—*Rep.*). He justly ascribes to the coarser disturbances in the perception of tones a great prognostic importance. In the *alterations* of the perception of tones the author distinguishes *three types*: 1. Uniform reduction of the perceptive capacity for all tones. 2. Diminution or extinction of the hearing power from a certain limit toward above or below, uniformly for a whole tone series, so that, for instance, patients who hear the tone series downward as far as contra-G, quite or nearly normally, show an evenly progressing diminution of perception toward the higher and highest tones, and the opposite. In a number of patients who hear the respective tones not as well by air-conduction as by bone-conduction, we may conclude (in connection with the objective condition of the middle ear) that we have to deal mainly with alterations in the dynamic activity of the sound-conducting apparatus. With uniform reduction of both bone- and air-conduction, however, we should assume pathological alterations in the nervous apparatus. 3. Irregular absence of single tones (tone-lacunæ), a more defective condition of perception, points to disease of the labyrinth.

On the whole, the middle series of tones are more rarely affected than the high and the quite low ones.

The author anticipates an elucidation of the function of the *other parts of the labyrinth* from the further advance in the analytical method of testing the hearing; while the present investigations afford to his mind a confirmation of Helmholtz's view in regard to the function of the *cochlea* in the act of hearing.

In conclusion, Dennert gives a most excellent advice as follows: "In the analytical method of testing the hearing, in the combined form by air- and bone-conduction, we have a means for specializing the summary result of the test, and of the capacity of the auditory organ, and thus for localizing pathological processes. Thereby we are also furnished a better direction for therapeutic action. On the one hand, this would be accomplished by our be-

ing in the position, usually after the result of the first examination, to dismiss as incurable, according to the present state of science, with only the necessary dietetic regulation, quite a number of patients—a fact more in consonance with the interest of patients and the dignity of science than their discharge, after long, often painful operative treatment, unimproved or perhaps even worse than before. On the other hand, by the aid of this method, the indication of local treatment, especially by the air-douche as well as by operative interference, may be better formulated."

4. After Nussbaumer, in 1873,<sup>1</sup> had called attention to the fact that in a few men vivid perceptions of color are associated with tones and chords in such a manner that certain colors and tones belong together, BLEULER and LEHMANN have instituted a series of experiments which confirm and amplify Nussbaumer's statements. In about the eighth part of all the persons experimented upon, it could be demonstrated that on hearing certain sounds or tones, they compulsorily saw fields of varying shape and color. The authors call this phenomenon "*sound-photisms*." Inversely, *auditory* perceptions may likewise be compulsorily evoked during the act of seeing, but this is more rarely observed. In the same manner, by sensations of smell, taste, and touch, phenomena of association may be produced in the auditory centre. Bright perceptions of light are mostly evoked by high tones, pains, and pointed forms; in like manner, high sound perceptions are produced by bright light. Perceptions of light are most frequently observed on hearing loud vowels, likewise in such a way that the deeper vowels produce rather darker color-perceptions; *e. g.*, the vowel *a* was designated as black 15 times; blue and blue-black, 10 times; red, 15 times; and white, only 6 times; *e*, however, was never perceived as black, but 28 times as yellow, and *i* likewise never black, but as white 37 times in 53 cases. These exact investigations may perhaps in future furnish some valuable contributions to the physiology of the cerebrum.

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<sup>1</sup> *Wien. Med. Wochenschr.*, 1873, Nos. 1-3.

## SUPPLEMENTARY NOTE TO THE REPORT OF THE MEETING OF THE AMERICAN OTOLOGICAL SOCIETY.

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### SELECTION OF TEST WORDS ACCORDING TO THEIR LOGOGRAPHIC VALUE.

BY CLARENCE J. BLAKE, M.D., BOSTON.

In default of a single adequate test of hearing power, and the necessity, therefore, for the employment of a series of tests, comparative merely, and each including only a portion of the scale of audition, it is, of course, important that the standard of each of these controlling tests should be as nearly as is possible definitely determinable.

Of the various means of testing at our command, the human voice, while of great comparative, is of but little absolute individual value, for the obvious reason that its great variability and the extreme difficulty of ensuring or of measuring any fixed degree of tensity which may be acceptable as a standard, render it unreliable for purposes of exact investigation. Still, the fact that in the majority of cases of aural disease causing deafness, it is the diminished power of hearing the human voice which has led the patient to seek relief, emphasizes the importance of including the voice in the series of tests which may be used in the first examination, or continued for comparison during the course of treatment. Much, indeed, may be done toward arriving at an idea of the degree of disability in this respect, by a careful use and modulation of the voice in conversation with the patient, especially if words are judiciously chosen and justly articulated.

At the best, however, a test of this sort is but vaguely comparative, and its result must often be accredited rather as an im-

pression of the amount of the disability than as a measure of its degree.

The selection of a series of test words is a step forward in the direction of a determinable standard ; though upon whatever basis the selection is made, it leaves much to be desired on the score of accuracy, until more adequate means of determining the sound value of the human voice are discovered that at present seems possible.

With the accurate means at our command for testing the hearing for pitch, by the aid of musical instruments, the selection of test words according to the musical value of the component consonant sounds would seem to be in a measure superfluous, and for this reason I have preferred, instead of using the consonant combinations suggested by Wolf, and others, to make a selection based upon the logographic or force value of the consonant sounds.

The method of making logographic tracings has already been sufficiently described elsewhere.

In utilizing these tracings for the purpose of comparing the force values of the consonant sounds, the tracings, made upon smoked glass or mica, are placed upon paper ruled in squares of millimetres and tenths, and the number of these divisions included within the space bounded by the logographic curve and its base line is taken as the logographic value of the consonant sound traced, expressed in assumed units of force.

The comparison of a large number of tracings goes to show that while the force value of the consonant sounds differs largely in different individuals, and differs also in the same individual at different times, the comparative value of the consonant sounds, one to another, bears a fairly, though by no means absolutely definite ratio. If, therefore, we take the consonant sound which requires the greatest force in its production, which has, in other words, the greatest logographic value, and which would be most readily heard, and express its value as 100, and that of the other consonant sounds accordingly, we have a table from which we may select the materials for a list of test words based upon the intensity rather than upon the pitch of the voice tone produced, and serving, as in cases of chronic middle ear disease for instance, as a measure of the obstruction presented to the passage of the sound. In compounding words from this table, it is better to use monosyllables, and it should, moreover, be kept in mind<sup>1</sup>, that the logo-

graphic value of consonants formed at the back of the mouth is greater in combination with the lower-pitched, and of the front consonants in combination with the higher-pitched vowel sounds. The logographic value of T, for instance, is somewhat greater in the word *tip* than in *top*; and of G, in *got* than in *get*.

T	100	F	35
B	53	K	31
P	58	L	21
D	45	N	11
G	56	M	9
S	40		
Z	63		
C	62		



REMARKS UPON THE CONCLUSIONS OF DR. POLL-  
NOW IN HIS PAPER "UPON THE DISEASES  
OF THE EAR IN RAILROAD EM-  
PLOYÉS."

BY S. MOOS, OF HEIDELBERG.

(Translated from the German.)

I STILL hold that it is doubtful if we can agree with the view of the railway officials, which is as follows: "Locomotive engineers and firemen hear sufficiently well, so long as they can follow a conversation carried on in an ordinary tone of voice."

It was exactly this rule that led one of two good physicians into error in my second case, in declaring that the engineer Kraft had normal hearing power, and that in this case he was responsible for the accident, and yet Kraft had only a hearing power of *one metre for a loud tone of voice*. I know very well that the result of my investigations is inconvenient to many railway employés. If the conclusions of Dr. Pollnow are adopted, there will be no need of medical examinations of these men. In the case just cited, the omission of such examinations would imperil the course of justice.

In my fourth case, the hearing distance was only a metre for a whisper, on one side; and, on the other, zero. The employé in question came to me of his own free will, because, in spite of the hand signal, he no longer found himself certain in his work "At a length of a train of twelve carriages, he could not hear the mouth whistle while the train was

being shunted (beim *manovriren*); the hearing power was only sufficient for the length of *four* carriages, with this signal." When we consider that the hand signal, at least in the railways of Baden, is not official, *i. e.*, no employé can be held accountable if he neglects it in the shunting, such facts as have been cited above are of more weight.

Finally, I may add, as regards the experiments of Pollnow with the fulminating signal (torpedoes), that all the employés examined by this test (Nos. 3, 20, and 29 of the table) still had hearing power for a whisper, which none of the employés examined by me possessed.

REPORT OF THE SECTION FOR DISEASES OF THE  
EAR AT THE INTERNATIONAL MEDICAL  
CONGRESS HELD IN LONDON FROM  
AUGUST 3 TO AUGUST 9, 1881.

By H. KNAPP.

The otological section was well attended, there being between 20 and 40 members present at every meeting. The papers were varied and the discussions animated without ever becoming animose. In the "temporary museum" our particular attention was attracted by Prof. A. POLITZER's extensive collection of very elaborate specimens of the different parts of the temporal bone, and numerous large crayon drawings illustrating the clinical features of the diseases of the membrana tympani and other parts of the outer and middle ears. The introductory address of the president, WM. B. DALEY, of London—printed in full in *The Lancet*, August 6th; p. 237,—was elegant and suggestive, touching on the many topics which, of late, have been elucidated by the united work of different nations, or are still under discussion: for instance, the somewhat uncertain and indefinite position of the operations on the membrana tympani, the temporary or permanent loss of hearing primarily due to emotional influences, as the witnessing of the sudden death of a near relative, the fright produced by a cry of fire, the alarm of burglars in the house, the terrible sight of a man cutting his throat, the receipt of great good fortune which had not been anticipated, etc. Such cases, examples of all of which had come to his notice, and a great many other observations, awaited their explanation.

The first subject of discussion: *On the value of operations in which the tympanic membrane is incised*, was introduced by Dr. GUYE, of Amsterdam, who said, that having been requested to

introduce this subject at a very short notice, he would state only his own experience. He classified the cases in which he had incised the *Mt* into four groups.

1st. Cases of simple chronic catarrh, aggravated by cold or some other cause. The results of the incision were generally very good, abridging the duration of the morbid process.

2d. Cases of subacute or chronic catarrh with consistent masses of mucus, which cannot well be removed in any other way. Results of incision excellent.

3d. Cases of chronic catarrh with symptoms of disorder in the inner ear, tinnitus and vertigo. Results in some cases good, in others insignificant.

4th. Cases of paradoxical inflammation of the tympanum with grave symptoms of fever, pain, etc. The characteristic feature of these cases, of which Dr. Guye has seen only two, is that the Eust. tube remains widely open, thus preventing the natural course of the morbid process, which would be a spontaneous perforation of the *Mt*. In both these cases the result of the incision was very good, probably because it opened the way for injections of carbolic acid through the tympanum and tube into the pharynx.

Dr. A. PAQUET, professor of medicine in the Faculty at Lille, read a paper on *A modification of myringectomy for sclerosis of the ear*, of which the following is the official abstract :<sup>1</sup>

“The myringectomy which I propose, and which I have found successful, is a combination of that of Weber Liel’s, in which there is section of the reflected tendon of the tensor tympani muscle, and of that in which an incision, with or without excision of a portion of the membrane, is practised. The blade of the knife I use is two millimetres in breadth and four in width, bent slightly, like a scythe.

“The procedure is as follows :—A puncture is made  $1\frac{1}{2}$  millimetres in front of the hammer, and the membrane is divided obliquely, downward and backward, in such a manner that the lower extremity of the incision is placed halfway between the umbo and the periphery, and at a point where a line drawn vertically downward from the umbo would meet it. This incision divides not only the membrane, but also the reflected tendon of

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<sup>1</sup> Those portions of the present report which are put in quotation marks, are copied from the official abstracts which the authors of papers had to send in before the meeting of the Congress, the others are from my own notes.—K.

the tensor muscle, or at least the tensor ligament of Toynbee. A second incision is now made in the posterior segment two millimetres from, and parallel with the manubrium, and then passes forward to meet the lower end of the first incision. By excising a portion of the lower end of the V-shaped curtain thus made, the perforation is rendered durable."

Prof. VOLTOLINI, of Breslau, performs paracentesis of the *Mt* when there are exudations in the tympanic cavity. Such exudations are much more frequent than is commonly supposed. Even if they cannot be recognized when the drum-head is thickened, we may find them against our expectation. The diagnosis is essentially aided by the use of sunlight for which he employs Prandom's mirror.

Dr. LÖWENBERG, of Paris, incises the *Mt* when there is too small a natural opening for the escape of copious secretions of pus.

He thinks that paracentesis for diagnostic purposes, is unjustifiable, but that it is of great value therapeutically. In acute cases the artificial perforation is preferable to the natural, because the former can be followed immediately by antiseptic treatment protecting the parts against infection from outside, which, after the spontaneous perforation, is apt to occur.

Dr. THOMAS BARR, of Glasgow, thinks paracentesis of importance when, by thickening of the drum membrane, a spontaneous rupture is difficult. In accumulations, he performs it when there is distinct bulging and fluctuation, as is frequent in children. In other cases he does not ascribe great value to the operation.

Since Dr. Paquet extends the indications of incision to otitis sicca, Dr. F. M. PIERCE, of Manchester, asks what advantage incisions of the *Mt* can have in sclerosis, where they relieve none of the bad conditions.

PAQUET and others advocate incisions in these cases for the sake of relieving abnormal tension.

Dr. GELLÉ, of Paris, has often made incisions of the *Mt*, but they all closed again.

PAQUET.—We must not make incisions, but excisions of the *Mt*. The more extensive the excisions, the greater the chances for a permanent opening. In practising excision, it is of importance to avoid wounding the labyrinth wall of the tympanic cavity, which requires a good deal of dexterity. He excised the greater part of the tymp. membrane, and never saw inflammation follow. In three of his cases the opening was permanent.

Mr. U. PRITCHARD, of London, confirms the improvement of hearing in cases in which the perforation can be kept open.

Dr. J. PATTERSON-CASSELS, of Glasgow, also speaks in commendation of paracentesis for relieving tension, but where he performs this operation most frequently is in cases of serous catarrh, with accumulation of fluid in the tymp. cavity. In this way he has cured 95 per cent. of these cases; in 2 per cent. inflammatory reaction followed. The value of intratympanic injections, he says, is a myth, because they do not solve the mucus.

Dr. JONES, of Chicago, advocates paracentesis in acute cases; in chronic, he removes the mucus by injections through the Eust. tubes.

The second subject for discussion: *Morbid growths within the ear, and their treatment*, was introduced by an extensive paper of Dr. J. PATTERSON-CASSELS.

*On the ætiology of aural exostoses, and their removal by a new operation.* The author asked permission to read only the conclusions:

“The osseous tumors of the external meatus are of two kinds: the one, named hyperostosis, being a hyperplasia; the other, exostosis, being a new growth. These differ from each other in origin, site, shape, structure, and number.

“Hyperostosis is never seen till the osseous meatus is completely ossified; exostosis appears before the complete ossification of the meatus. Exostosis is found arising from a point near the junction of the osseous canal with its cartilaginous portion; hyperostosis is seen only in the inner or osseous end of the external auditory canal. Hyperostosis is always conical in shape, never pedunculated; in exostosis, on the other hand, there is always a pedicle, and its shape varies. Hyperostosis is of ivory hardness; exostosis, before complete ossification has taken place in the tumor, can be pierced to a varying depth. Hyperostosis is not movable on pressure; exostosis is slightly movable, even when complete ossification has taken place. Hyperostosis is often seen without any other disease of the ear, and if an ear disease exists, there is no causative relation between them; they exist altogether independently, and apart from each other. Exostosis is nearly always complicated with another affection of the ear, past or present. Hyperostosis, therefore, may exist in the meatus with normal hearing. Exostosis, on the other hand, is almost always



attended by a defect in the hearing. The operation for the removal of hyperostosis is only justifiable, when its mechanical presence has been ascertained to be the sole cause of the deafness, or when a coincident ear discharge exists, the escape of which may be hindered or altogether arrested by the presence of the tumor. The commonest cause of deafness in hyperostosis is the presence of débris around the tumors, either cerumen, epidermic masses, or other matters, or the mechanical irritation and inflammation of the tissues that cover the tumors. The hearing is mostly restored on the removal of the débris or inflammation. The operation for the removal of hyperostosis is best effected by a mechanical drill, such as dentists use ; this is the safest method of removal.

“For the operation of the removal of an exostosis a gouge is the best instrument, because the tumor can be removed at one operation, whereas a hyperostosis usually demands several operations, as well as separate sittings, for its complete removal, when this is possible. There may be several hyperostoses in an ear, but hardly ever more than one exostosis. Both classes of tumors may exist together in the same ear.”

Then followed a paper of Dr. LAWRENCE TURNBULL, of Philadelphia, of which, in the absence of the author, the Secretary read the official abstract: *Morbid growths of the ear, and their treatment* (with cases), in which were enumerated the different kinds of tumor observed in the three parts of the ear, as well as in the cranial cavity, involving the acoustic and other nerves.

Attention is drawn to “fatty metamorphosis of the organ of Corti, resembling sarcoma of the auditory nerve, as described by Moos, amyloid degeneration of the auditory nerve, as described by Voltolini, and corpora amylacea, found in the semicircular canals of man, and described by Lucae.

“*Treatment.*—Where the growths can be reached, the only successful plan of treatment is the early removal by excision by the knife, preventing danger of hemorrhage by the use of the ligature, clamp-forceps, thermo- or galvano-cautery. Removal of diseased bone by forceps, sharp spoon, revolving knives, or the surgical or dental engine.

“The most important plan of treatment is the removal of all vascular or polypoid growths as soon as they are brought to the notice of the aural surgeon. All puncturing or irritating of the above growths by means of needles, small sharp knives, or caus-

tics, is to be entirely avoided, for, in our experience, all such meddlesome surgery tends to increase and inflame them, and may change an originally benign growth into a malignant one."

A very interesting observation by Prof. A. POLITZER, of Vienna, was, in the absence of the author, communicated by the writer of this report, on *A case of carcinoma of the middle and the inner ear*. The pseudoplasm seemed to have originated in the tympanic cavity. It had grown both outwardly and inwardly, and terminated fatally by its extension into the cranial cavity. The most interesting feature of the observation lay in the fact that the growth had just begun to encroach upon the labyrinth, without yet having destroyed the soft parts. Vertical sections through the cochlea (of which a large drawing and several microscopic specimens were demonstrated by the speaker, and examined with marked attention by the members) showed one convolution almost normal,—only some tumor elements being situated on the upper part of the stria vascularis and in the ductus cochlearis; whereas in a second section the scala tympani was almost completely filled with tumor elements, and in a third both scalæ were invaded by considerable masses of the growth.

*Discussion on the tumors of the ear.*

Dr. GUYE.—One exostosis may occlude the auditory canal completely; when there are several they always leave a hole.

Dr. LÖWENBERG has seen two exostoses joined by an osseous bridge.

Dr. PIERCE has seen a case where the canal was closed by a single exostosis. Purulent inflammation and cerebral symptoms were present. The exostosis was drilled and the mastoid opened; the exostosis returned.

Dr. GELLÉ spoke of the exostosis of the prehistoric inhabitants of Peru. The tumors were on the anterior and posterior parts of the canal. He found them present in 16 out of 66 skulls.

Dr. KNAPP said that through the kindness of Dr. Cl. J. Blake, who had found them frequently in the Mound Builders of Tennessee, he had seen such skulls in the Peabody Museum of Boston. Exostoses were noticed in about 40 out of 250 skulls examined, and occupied the tympanic part of the canal. There was no symptom of syphilis in the skeletons of the Mound Builders. Virchow, with whom he had lately had the privilege of speaking about this subject, said that those bony excrescences were sup-

posed to have resulted from foreign bodies, which the savages used to put in their ears.

As to the multiple mammiform exostoses, Dr. K. stated that in a low degree of development they were not at all infrequent, but were easily overlooked. Their growth was commonly very slow, and they mostly became stationary after a certain time. He was not quite sure whether they never met so as to occlude the canal completely. He had seen a case where the skin had coalesced, but on incising it, a fine probe could be passed through a central aperture between the crests of the elevations. He had successfully chiselled the opening larger. He had seen complete bony closure, but was unable to tell whether it was produced by multiple exostoses or otherwise.

As to hyperostosis, he thinks that syphilis is one of the principal causes, and relates a case of complete deafness from it, which proved incurable in spite of the greatest care and anti-syphilitic treatment, continued for six months.

Mr. PRITCHARD states that exostoses, according to his observations, are rare in hospital practice, but common in private. He thinks that they chiefly result from gout and rheumatism. He attacked one case with a chisel, but had to desist after an hour. On the use of nitric acid, the tumor became loose and exfoliated.

Dr. JONES has seen an exostosis disappear spontaneously.

Mr. GARDINER BROWN thinks that syphilis and gout, especially the latter, are the chief causes. He uses a conical drill.

Dr. REEVES, of Toronto, says that they are mostly the result of purulent otitis media.

Dr. SAPOLINI, of Milan, remarks that there are soft and hard exostoses; the former sometimes disappear spontaneously.

Dr. GELLÉ mentions that in one case he has seen a polypus originate in a psoriasis patch. Psoriasis of the ear canal is quite frequent.

The third subject for discussion was: *Loss of hearing where the external and middle ears are healthy.*

Dr. GELLÉ, of Paris, read a paper on *Nerve-lesion deafness*, illustrated by cases, of which the reporter regrets having been unable to take notes.

Prof. LUCAE, of Berlin, made some remarks on the *Physical diagnosis in cases of deafness with healthy conditions of the outer and inner ears.*

The remarks were illustrated by demonstrations of Rinne's method of applying the tuning-fork. He began by disproving Mack's theory of the escape of sound through the canal in cranial conduction.

"The usual determination of the condition of the inner ear, by placing a tuning-fork on the cranium, is sufficient. There may be conditions present which cause a pathological increase of the sound-perception.

"The proving of the functional activity is more fully determined by placing a deep fork (*C*), the vibrations of which have just ceased to be perceived by the acoustic, while placed on the mastoid process, opposite the meatus, and noting if the vibrations not perceived on the mastoid process are perceived in this position. The longer the fork is heard opposite the meatus, after it has ceased to be perceived through the mastoid, the more certainly is a complication in the sound-conducting apparatus excluded. On the contrary, should the note be heard longer from the mastoid process than opposite to the meatus, a disturbance in the sound-conducting apparatus is determined; but in this case there remains the uncertainty as to there being an affection of the inner ear present at the same time. In order to determine this more fully, the use of the tuning-forks (*C*<sup>4</sup> and *F*<sup>4</sup>) are useful, which are heard relatively well, even with a considerable affection of the conducting apparatus, but very feebly with disturbances of the nerve apparatus.

"For an exact determination, the time during which the corresponding fork is heard by the patient and the observer should be compared by means of a chronoscope, the difference of the time in seconds denoting the degree of disturbance."

Dr. STEVENS, of New York, read a paper on *Certain conditions of the eyes as a cause of loss of hearing by reflex irritation*, of which the reporters were unable to take notes.

Dr. KNAPP related a case of one-sided complete and incurable deafness from mumps, that had recently come under his care. The tuning-fork was perceived by bone-conduction only on the healthy side, by air-conduction well, and in puffs on the healthy, feeble and even on the deaf side. The middle ears were quite healthy. Such cases had been very rare in his practice, whereas he had frequently seen epidemic mumps complicated with acute perforative or non-perforative otitis media.

W. B. DALBY stated that he had quite frequently seen one-sided, and sometimes sudden deafness in mumps, and double-sided without any lesion of the middle ear.

Dr. BABER has, like Lucae, found Rinne's experiment useful.

Dr. PIERCE spoke of reflex action from plugs of cerumen and other foreign bodies in the ear.

Dr. KNAPP called attention to the observations of blindness and deafness from large doses of quinine (3 grm. and more, *pro die*), recently published in America (the last numbers of the *Arch. of Ophthalmology*). The deafness is complete, but commonly lasts only a day; the blindness is likewise total, but the recovery is very slow and frequently incomplete. A marked and lasting contraction of the visual field being one of the essential features, Dr. K. tested the hearing with that point in view, but found after the recovery the hearing perfect in all respects: acuteness, perception of high, middle, and low tones, and of timbre. Middle ear and *Mt* were found normal, also during the attack. The excessive pallor of the optic disc, with almost invisible blood-vessels, noticed at the outset of the poisonous effect, and in the grave cases remaining permanent, suggests a similar condition of ischæmia in the cochlea.

This communication gave rise to a lengthy discussion on the effect of quinine on the ear, in which Dalby, Jones, Gellé, and others took part. No one had noticed total deafness ensue from quinine, but it was stated that when taken for a long time, quinine produced hardness of hearing by nervous exhaustion, though the beneficial effect of long-continued use of the drug for noises, vertigo, etc., as recommended by Jacoud, Charcot, and others, was confirmed by Gellé.

The discussions on the official subjects were followed by the presentation of a considerable number of *original papers*, the majority of which excited more or less extensive discussions.

Dr. C. E. FITZGERALD, of Dublin: *On objective noises in the ear*, does not think that they result from the contractions of the tensor tympani, but from the muscles of the pharynx.

LÖWENBERG remarks that Politzer was the first to advance the explanation according to which they were caused by a violent separation of the walls of the tube. L. found that after successful catheterization of the tube these noises were apt to cease.

Concerning other noises, Woakes said that hydrobromic acid gave relief only in pulsating tinnitus.

Dr. H. KNAPP, of New York : *The cotton pellet as an artificial drum-head.* Its acoustic efficacy was found demonstrable in more patients than he formerly thought, and in some it was so great and lasting as to yield the most gratifying results. Its protective effect consisted in the protection of the middle ear from atmospheric influences. As one of its curative effects, he stated that wicks of good absorbent cotton acted as excellent drainage-tubes in chronic otorrhœa. The mechanism of its action was different in different cases. In some, in which the tensor tympani exerted too strong an inward pressure, it counteracted that effect by pressure on the short process and other parts of the ossicles situated above their axis of rotation ; in others, where the malleo-incudal and other joints were loosened, it acted by pressure on the handle and those parts which were situated below the axis of rotation. Politzer (communication by letter) had been able to confirm these views by experiments on patients. A most important action of the cotton pellet was to regulate the moisture in the drum cavity : on the one hand (in profuse otorrhœa), checking over-secretion ; on the other (in sclerosis), stimulating secretion, thus keeping the parts in the best conditions of vibratility. Besides the cotton pellet, he, like C. H. Burnett, had found Blake's little paper discs to afford great aid to hearing in certain cases of old perforation.

The artificial drum-head was discussed at considerable length, and mostly commendatorily, by the chairman and many members present.

E. CUMBERBATCH, of London, has seen cases in which the hearing, improved at first, decreased in later years. He had to employ greater pressure.

CZARDA, of Prag, uses and recommends a silk artificial drum-head.

McMILLAN uses cotton first, then discs of wood. He also thinks that the pressure has to be increased later.

CASSELS has likewise used the artificial *Mt* with advantage for years. He did not find that it lost its efficacy ; on the contrary, it improved the natural hearing gradually, so that the patients could dispense with the artificial aid.

Dr. A. GARDINER BROWN, of London : *The sense of touch as a standard of comparison for hearing-power.*



"For examining auditory perceptivity the tuning-fork is to be preferred to the watch. The Middle-C fork (= 256 v.s.) is an excellent standard of pitch, corresponding as it does with about the middle of the compass of the human voice as used in conversation. When the 'field of audition' (Knapp) is being determined, higher and lower pitches are made use of.

"Hitherto the best way of employing a tuning-fork has been to strike it with a measured blow to insure uniform amplitude of its vibrations, instantly applying it to the patient's head and noting the *duration* of his hearing-power (Magnus).

"The author has now conceived the idea that the point in the lessening amplitude of the vibrations corresponding with the moment of their loss to the sense of touch in the thumb and finger of the examiner, forms an excellent and convenient standard of reference for the auditory perceptivity of the patient.

"Hearing-power, falling short of this point, the author has designated as *minus*, that exceeding it as *plus*, time being reckoned in half seconds (to save fractions); this may be done by means of a stop-watch, but the author prefers simply *counting* in half-seconds, easily and accurately done after a little practice; or the time may be estimated by a tubular sand-glass, which he has had constructed for the purpose.

"The most suitable points for ordinary examination are over the mastoid for bone-conductivity, and at the focus of the concha for aërial sound-waves.

*"Example of Use of Middle-C Tuning-fork."*

"Case of P. S., æt. 46, simple middle-ear catarrh (left side).

	Right Ear.	Left Ear.	Left Ear (after Politzer inflation).
Over Mastoid	. + 9	+ 13	+ 13
Focus of Concha	. + 17	— 13	— 5 "

Dr. GELLÉ read a paper on the *Accommodation of the ear*, which he, of course, thinks to be affected by the muscles of the ear. The reporter's notes are too insufficient to do justice to Dr. Gellé's views on a subject which has, rather unsuccessfully, been touched upon by several others.

Dr. E. WOAKES, of London, summarizes what he communicated in a paper read before the Brit. Med. Ass., at Cork, in 1879 (pub-

lished also in the *Amer. Jour. of Otology*, Oct., 1879), and "in the present paper he contributes his further experience of the disease, adding thereto some illustrative cases." As the essential features of paretic deafness—"neurotic lesions of a paretic character of the muscular apparatus of the middle ear, including the tubes,"—he mentions absence of changes in the *Mt* and of tinnitus and non-progressive impairment of hearing.

Dr. F. M. PIERCE, senior surgeon to the Institution for Diseases of the Ear, Manchester, contributed an important paper on *The action of syphilis on the ear*.

"The effects of congenital and acquired syphilis on the ear are less observed than its effects on the eye, teeth, skin, etc. Syphilitic ear affections are analogous to corneo-iritis and amaurosis.

"Primary sores of the ear are very rare; secondary squamous, pustular, and papular eruptions are common. (Cases quoted.)

"The evidence of syphilis attacking the middle ear is mainly of a catarrhal character, with a marked prevalence of anomalous auditory-nerve symptoms, and, in adults, these symptoms are suggestive of acquired or congenital syphilis as a predisposing cause.

"(Forty cases of acquired syphilis affecting the ear referred to.)

"Inherited syphilis is manifested from 11 to 18 years as average; most frequent in females, as 4 to 1.

"Access of deafness gradual but rapid; in from three weeks to one year. About period of puberty in females, rather later in males.

"The membrana tympani dull, pearly opacity, collapsed, the light spot large and dull, and the manubrium red, flat, and retracted. The meatus dry and polished. The nasal passage swollen, and seat of chronic thickening and discharge.

"The deafness generally preceded by specific chronic interstitial keratitis, recovery from which is signal for accession of extreme deafness of a very intractable character. The early decay of the characteristic teeth of hereditary syphilis produces frequent earache.

"(The effects of congenital syphilis of the ear have been noticed in thirty-five cases.)

"As a summary of the characteristics of acquired and congenital syphilis affecting the ear we see:—

"1. Extreme degree of deafness manifested early in the progress of the disease.

"2. Rapidity of progress and absence of pain.

"3. Early and extreme loss of hearing for the tuning-fork over the vertex.

"4. Frequent imperviousness of both Eustachian tubes.

"5. Constancy of the tinnitus, of a hissing kind.

"6. Frequency of simultaneous inner-ear symptoms.

"7. Improvement of pre- or co-existing eye affection.

"8. More decided affection of the naso-pharynx than in catarrhal ear disease.

"9. Less complete recovery than in simple catarrh.

"Intolerance of sound, like that of light in syphilitic eye affections, is not a noticeable feature in syphilitic ear affections."

Dr. THOMAS BARR, of Glasgow, read a paper on *Caseous accumulations in the middle ear, regarded as a probable cause of miliary tubercle*.

"Pathologists generally agree that acute tuberculosis depends on a virus, and that this virus often consists of caseated products of inflammation accumulated in some part of the body.

"The peculiar structure of the middle ear favors the retention, drying, and ultimate caseation of the catarrhal products formed therein.

"Facilities for the absorption of the caseated matter are afforded, first by the blood-vessels of the middle ear, and secondly by the lymphatics; absorption by the former leading to general tuberculosis, and absorption by the latter to local tuberculosis and especially to tubercular meningitis.

"There is special danger of tubercular self-infection when such caseous collections exist in persons of scrofulous tendencies or at the tubercular age. There is a stage in the purulent process when there is greater danger of pyæmic phenomena; but there is also a stage when the tendency to tubercular self-infection is greatest, and that is after the discharge from the ear has spontaneously ceased, or has been cured by treatment.

"The chief objection offered by the opponents of the theory of self-infection of tubercle by the absorption of caseous collections is, that cases of tuberculosis are seen where no caseous virus can be found in any part of the body. May it not be that the search, in some at least of these cases, proves unsuccessful just because no inspection of the ear is made?

"It is urged, in conclusion, that when a case of tubercular disease, and especially of tubercular meningitis, comes before the physician,

or the pathological anatomist, attention should be given to the condition of the middle ear."

According to the reporter's notes, Dr. Barr came to the conclusion that the ear disease in phthisis was a coincidence or a symptom of the general tuberculosis, not its origin. This statement seems to be so much at variance with the official abstract of the paper, as to make the reporter suspect that the bias of his own mind has led his pencil in a wrong direction.

Dr. ARTHUR KINSEY read an elaborate paper on the *Prevention of dumbness in those cases where it follows loss of hearing*. He dwelt on the advantages of teaching the deaf how to speak. Very extensive statistics on deaf-mutism from different points of view are given, of which the following are of particular interest: Deaf-mutism is found in 1 case out of 19 marriages when both parents were deaf-mute, in 1 case out of 130 of one parent only being deaf-mute, in 1 case out of 6,000 of both parents hearing well.

Dr. BOUCHERON communicated the case of a girl, æt. 2 years, who had meningitis and, four weeks later, scarlet fever. Her hearing was impaired, and she could not walk. A few Politzer inflations restored both the hearing and the walking. B. thinks that in this case increased pressure on the inner ear was present, and makes some remarks upon the tension in the ear, basing his determination upon the height of pressure in different parts of the vascular system.

Dr. GARDINER BROWN made some remarks on the physiology of the auricle, stating that the auricle is a resonator of sound, and that the different muscles sharpen different sounds.

Dr. LÖWENBERG, of Paris, read a paper, in which he dwelt on the *Importance of examining the nasal passages*, which should be done as a routine matter in every case of ear disease—anterior rhinoscopy. He dilates the nostrils with a bivalve speculum, throws light in by a forehead-mirror, and then introduces the E. catheter. In this way he overcomes obstacles which otherwise would be insuperable.



# ARCHIVES OF OTOTOLOGY.

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## ON THE TOPOGRAPHY OF THE HUMAN VESTIBULE.

BY DR. H. STEINBRÜGGE, OF HEIDELBERG.

(*With plate v.*)

Translated by JAMES A. SPALDING, M.D., Portland, Me.

ON looking over some old specimens, I came across a series of sections which I once made for the purpose of examining the topography of the various structures in the vestibule. These sections had been made rather thick, in order to preserve the membranous portions, and were, therefore, hardly suitable for investigating the finer microscopical details. Nevertheless, repeated examinations brought out a few topographical relations which may be of some future practical value.

Although it is well known that the membranous sacculi of the vestibule, corresponding to the shape of the two recesses, do not quite fill the entire vestibule, or, in other words, that a space is left on the inner surface of the stapes which is only filled with perilymph, yet, as far as I know, these relations have never yet been accurately measured, at least in man. For this reason I have made drawings, in double the natural size, of several of these specimens, and herewith offer them to the profession.

Figs. 1 to 8 represent horizontal sections (running from above downward) through the right vestibule and utriculus. They only show a small portion of these two districts, since they begin on a level with the upper edge of the fenestra ovalis, just above the overlying facial canal, and terminate at the level of the lateral limb of the stapes. Within this



space the walls of the utriculus are entirely free from the orifice of any canal. In fig. 1, *f* indicates the facial nerve, which has been twice divided; *v*, the nerve of the vestibule; *c*, the connecting ligament. In figs. 6 and 7, *s* indicates a portion of the medial<sup>1</sup> limb of the stapes which has been preserved. The lateral limb (also marked *s*) is only reached in fig. 8, owing to its deeper position.

In fig. 9 we have a vertical section perpendicular to the long axis of the pyramid (right side), and intersecting the vestibule considerably toward the medial side, as is proved by the fact that the membrane of the fenestra rotunda (*m*) and the beginning of both scala are visible. The facial nerve (*f*) has been divided obliquely. *N* is the nerve which runs to the ampullæ of the sagittal and horizontal semicircular canals. *Ls* indicates the section of the lamina spiralis. The curved line running downward and to the left from the membrane of the fenestra rotunda corresponds to the section of a pseudo-ligament. Only the upper half of the utriculus could be preserved (attached as it was to the roof of the vestibule by numerous ligaments), owing to the fact that the section was rendered difficult by the presence of a stony enostosis<sup>2</sup> in the posterior wall of the vestibule. The macula, which has been divided perpendicularly, can be seen on the anterior wall of the utriculus. The medial surface of the section shows the recessus hemisphericus, with the sacculus, in the space between the anterior wall of the utriculus and the stapes, whilst the remaining portion of the utriculus fills the upper end of the recessus hemielipticus. The oblong body of the utriculus extends downward into the ampullæ of the frontal semicircular canal, while its anterior wall describes a curve, the concavity of

<sup>1</sup> On account of the oblique relation of the pyramid to the sagittal plane of the cranium, the terms "medial," "anterior," etc., might easily give rise to misconception. Hence, I beg to remark that by "medial" is meant the direction toward the summit of the pyramid; by "lateral," toward its base. "Anterior," in the vestibule, corresponds to the wall of the fenestra ovalis; "posterior," to the opposite direction. Therefore, in contradistinction to the usual terms, "anterior" and "posterior" limb of the stapes, the terms "medial" and "lateral" have been chosen.

<sup>2</sup> Moos and Steinbrügge, these ARCHIVES, vol. ix, p. 330: "On a peculiar modification of the bony structure in the pyramid of the temporal bone." Since this date, however, I have, unfortunately, found these enostoses in a majority of pyramids.

which is directed anteriorly (indicated by dotted lines, because the injured portion of the anterior wall of the utriculus is pushed too far backward in the specimen lying before us).

Fig. 10 represents a vertical section through the vestibule of the left pyramid, parallel to the long axis. The utriculus is removed. The upper fissure indicates the ampullar orifice of the horizontal and sagittal semicircular canals. The ampulla of the frontal semicircular canal (*af*) is visible beneath the floor of the vestibule. It has been divided obliquely by the section from in front backward, *before* its osseous canal entered the vestibule. Still, we learn something of its position, as well as of that of the nervous branch which enters it from the side of the cochlea (the specimen belongs to the left petrous bone). *R h* indicates the recessus hemisphericus, the periosteum of which closes over the so-called sacculus, in the bottom of which we see traces of the distribution of the nerve. The nerves which enter the pole of this recessus are only seen as cross-sections at the left side of the figure, owing to the fact that the section happened to fall on the further side of the pole. Hence this figure represents only a segment from the posterior half of the recessus hemisphericus.

In fig. 11 we can see the entrance of the vestibular nerve into the vestibule, and its coarser distribution in the macula, the situation and extent of which can be passably well determined by combining the horizontal section with the vertical section (fig. 9). I will venture to call attention to the fact that even at the level of the medial limb of the stapes (*s*, fig. 6) the nerve no longer penetrates the bone, while the macula ceases even above this level. The vertical section, fig. 9, confirms this relation of the parts. Several blood-vessels are visible in fig. 11, just below the nerve. The vessel which has been divided longitudinally is an artery. The other cross-sections have not been distinctly preserved; some of them seem to be merely fissures for vessels within the osseous tissue.

A careful examination of all the sections will demonstrate, first of all, the regular ellipsoidal figure of the various sec-

tions of the vestibule, the major and minor diameters of which increase step by step from figs. 1 to 8. This regularity is somewhat interrupted by the entrance of the nerve, and in figs. 6 to 8 by the recessus hemisphericus (fig. 6, *r h*) advancing toward the side of the cochlea. Nevertheless, the latter irregularity is less noticeable in preserved specimens, since a portion of the periosteal connective-tissue layer, which lines the interior of the vestibule as well as the plate of the stapes, also stretches over the recess in question, whilst horizontal sections through the vestibules of macerated bones give a more pear-shaped figure (compare Henle). Moreover, the roof of the vestibule in fig. 9, in connection with its anterior wall, which passes directly over into the plate of the stapes, shows a certain amount of regularity, as is also the case with the floor of the vestibule in fig. 10. If we combine now the configuration of the three sections, the vestibule will appear as a concavity, which we may compare, as it were, to an upright elliptical spheroid, or imagine that it had been produced by revolving the elliptical section in fig. 10 around its major axis.

I would, however, call especial attention to the free space, *v k*, fig. 11. We see the utriculus, in figs. 1 to 6, always united at the same spot (fig. 1, *e*) to the periosteum of the vestibule by connective-tissue fibres. It is also probable that the rest of its circumference is fastened by more yielding fibres, which have, however, become loosened in making the sections (compare also the attachments at the roof, fig. 9). Traces of ruptured fibres are also found on the periosteum as well as on the utriculus (compare fig. 11). The fibres designated at *e*, seem, however, to be especially firm, since they are seen in six consecutive sections. In Nos. 7 and 8 they are no longer visible; the tissues were probably too yielding to produce perfect pictures, as is also evident from the section of the wall of the utriculus in fig. 8.

The sheath which accompanies the nerve (starting from the periosteum and passing on to the wall of the utriculus) forms the medial boundary of the space *v k*, on the cochlear side, and can even be seen extending beneath the entrance of the nerve (figs. 6, 7, and 8) as a connective-tissue

diaphragm. It has been preserved, though in a defective condition, in figs. 7 and 8. Further downward, it seems to support the utriculus in position,

The space which we have mentioned, and which, moreover, lies adjacent to the anterior wall of the vestibule, *resp.*, the plate of the stapes, does not show any strengthening fibres, or even remnants thereof, in any of the figures. It is, moreover, probable, on grounds of fitness, that the plate of the stapes and the utriculus are not united by connective-tissue fibres.

Here, then, we have a sort of "anterior chamber," filled with perilymph, with dimensions increasing as well from above downward as from the lateral to the medial direction. For, as the diameters of the horizontal sections of the vestibule increase as we pass downward in the district just mentioned, those of the utriculus decrease, so that the size of the anterior chamber is increased in a twofold manner from above downward. Thus, at the upper edge of the fenestra ovalis, the *greatest distance* from the macula to the anterior wall of the vestibule measures 0.56 mm., while in fig. 8 the *least distance* between the anterior wall of the utriculus and the plate of the stapes measures 1.5 mm. Moreover, the vertical section, fig. 9, shows that this distance increases still more in a downward direction, as far as the *lower edge* of the plate of the stapes, while finally, the horizontal sections, figs. 1-8, demonstrate that the *smallest distance* always corresponds to the *lateral margin* of the plate of the stapes, and increases from there toward the cochlea.

*These topographical relations demonstrate that in operating in the region of the fenestra ovalis, we should be very careful in our movements near its upper edge, especially in the lateral portion, on account of the proximity of the macula of the utriculus. On the contrary, at the level of the lower edge we find a space which is only filled with perilymph, and would consequently allow the ligamentum orbiculare to be punctured (with greatest security in the medial half of the lower edge) without endangering the utriculus or the nerves of the vestibule. The sacculus also is moderately well protected in the*

*recessus hemisphericus, and would not be endangered by a puncture in the region named.*

In case the conformation of the auditory meatus allowed the passage of an instrument as far as the fenestra ovalis, this path might be used for the evacuation of hemorrhagic or purulent effusions in the vestibule, by means of a very fine canula or by aspiration, as has been suggested by Knapp.<sup>1</sup> The same canula could be used for the injection and subsequent removal of various medicated fluids. Even the presence of an imperforate *Mt* need not offer absolute hindrance to such an operation, for we could perforate its posterior portion with a trochar, remove the point, and then use the upper wall of the promontory as a guide for conducting the canula (compare fig. 9). It would also be desirable to experiment on subjects, with accurate determination of the angle of the head to the horizontal plane, in order to discover the point of election for perforation.<sup>2</sup> The desire which has been so long and so universally cherished of reaching, by surgical means, those affections of the inner ear which are inaccessible to our present medical treatment, must serve as an excuse for the boldness of any suggestions in this direction. But so long as an accurate knowledge of the topographical anatomy of the parts concerned in every surgical operation is of the first importance, I hope that this paper may fulfil its aim in this respect at least.

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<sup>1</sup> These ARCHIVES, vol. ii, part i, p. 281.

<sup>2</sup> Illumination by means of the electrical otoscope might be advantageously resorted to in case of a transparent *Mt*. Compare Zaufal, *Archiv für Ohrenhklde*, Band xvi, Abth iii, p. 188.

## HISTORY OF A CASE OF HEMORRHAGE FROM THE EAR, PROBABLY DUE TO A FRACTURE OF THE SKULL.—RECOVERY.

By J. D. RUSHMORE, M.D.

On July 21, 1881, I was asked to see a gentleman about 68 years of age, who, without more than a peculiar uncomfortable feeling in his head for a few minutes preceding his injury, had been seen, July 17th, to fall backward and toward the left side, in the street, and had lost in a few minutes about sixteen ounces (by estimation of a physician) of venous blood from his left auditory canal. He was taken to his home, tossing his arms and legs about with some violence on the way, and putting his hand to his head. He regained his consciousness in part in a few hours, and was able to answer questions coherently. He complained of headache, referred to left frontal and left temporal regions, with vertigo every ten or fifteen minutes whether lying still or moving, most marked, however, while turning the head, which he did with the greatest deliberation. His respiration had not been affected; his temperature was  $98\frac{3}{4}^{\circ}$ , his pulse 55. Bowels had acted in response to medicine; his urine during the day following the accident amounted to only seven ounces, contained about 5 per cent. albumen, a moderate number of hyaline and coarsely granular casts, and had a specific gravity of 1020.

He had always been an exceedingly methodical and a constantly occupied man, suffering from no organic disease. The character of the urine within a week or ten days became entirely normal, and remains so still, so that the renal condition may be eliminated from the case, whatever relation it bore to the original seizure, whether causal or consequent.

At my first visit I found the patient perfectly rational and able



to state clearly the symptoms of which he complained. They were the vertiginous attacks above mentioned, frontal headache severe at times, tenderness in front of, beneath, and behind left auricle, dulness of hearing in left ear. Objectively there was a slight œdema of left mastoid, a narrow ecchymotic spot extending from the mastoid toward the styloid process beneath the auditory canal, a hyperæmic auricle, a soft clot filling the canal, which was found to be much swollen and tender, especially forward and downward, after the clot had been removed. There had been no hemorrhage after first attack, nor was there any serous discharge. Hearing distance for the voice, 3 feet; watch, nil; tuning-fork heard well, better through the bones; right ear: voice, perfectly; watch, 1 inch; tuning-fork, better than with left and better through the bones. Right *Mt* slightly sunken and cloudy. Left *Mt* could not be seen on account of swollen condition of walls of the canal. There was a small, round, bright, and motionless reflex at bottom of canal. Both Eustachian tubes were patent; the air entered each ear easily and with no difference in sensations, except that in the left ear pain was produced all about the ear. Pulse, 50; temperature, 99°; respiration, 16; slight numbness of third and fourth fingers of right hand. This symptom has disappeared under the interrupted current.

The further history of the symptoms is:—

*July 27th.* Discharge of thick and very offensive pus of good color from ear. Hearing distance, 6 feet. Pain diminishing, œdema less, ecchymosis disappearing, vertigo less, some delirium while asleep. Seems to have little idea of passage of time, asking to have pulse taken just after it had been taken, asking when medicine was to be given again immediately after it had been administered, etc., etc.

*Aug. 1st.* Discharge very slight; canal still much swollen anteriorly and below; a small red granulation visible in upper wall of canal, deeply situated; could find no opening to bone through it. Temperature, 99°; pulse, 40–50, sluggish, but regular. Other ear symptoms improving; mental disturbances more marked; difficulty in recalling words; a suspicion, but nothing more, of left facial paralysis. This symptom attracted no further attention. Sleeplessness most troublesome symptom.

*Aug. 7th.* Discharge stopped; granulation on roof of canal gone; swelling and tenderness continue in canal; hearing distance, 8 feet; watch, nil; middle ear easily inflated by Valsalva

without pain ; appearance of integument over mastoid, normal ; no tenderness ; soreness when pressure is made over styloid process ; other head symptoms improving.

*Aug. 15th.* Sitting up and walking with assistance ; reading with pleasure. From this time there was a gradual improvement in all the symptoms.

*Aug. 25th.* Hearing distance was 15 feet, but *Mt* cannot be seen except upper and posterior part, which is of good color and is a little moist.

*Sept. 10th.* To-day, for first time, can see the whole *Mt*. The only additional light thrown on the case is the existence of a red irregular line, broad peripherally and narrowing toward the centre of membrane, extending from apex of light spot to the end of the malleus handle. The rest of the membrane looks as well as the right *Mt*.

*Sept. 25th.* The redness of line described above has entirely disappeared, and the color is like that of a thin, newly formed membrane ; the light spot is also extending up along the upper edge of the line in a faint streak of light. There is no tinnitus. The hearing distance for the voice is 15 feet, for the watch (loud ticking) contact ; the tuning-fork is heard not quite so well as with right ear, and better through bones than through the air. In all respects except the slight dulness of hearing in left ear the patient is as well as before he fell. The pulse, normally slow (about 50), has ranged rather below than above that number ; his temperature has generally been normal, once reaching  $99\frac{1}{2}^{\circ}$ , and two or three times  $99^{\circ}$ .

The treatment of the ear consisted in cleansing the canal, leeches to mastoid, warm applications external—the douche was objected to,—oleate of morphia in front of and behind auricle. After the patient was up and about, Politzer was used three times—each time with the same result—to dull the hearing power for conversation for the whole day, nor was there any improvement on the day following. As regards the general treatment, the most urgent symptom was sleeplessness, which was relieved at first by opium, potass. br., chloral, hyoscyamia, etc., and afterward better by rum, camphor, etc. Digestion was carried on well during the entire time, and other medication was largely expectant.

The point of especial interest in the case reported above was as to the source of the bleeding and the extent of the lesion.

From the symptoms as obtained by first examination it seemed as if there had been a fracture beginning in the external auditory canal and extending downward and forward, and that the hemorrhage had come from the internal jugular vein, and that the membrana tympani had not been ruptured. The subsequent progressive change in the appearance of the *Mt* proves that the membrane had been ruptured, and confirms, as far as it can, the probability of a bone lesion downward and forward. Of course it is well-nigh impossible to account for the sudden loss of blood in such quantities from this direction; but it is quite as difficult in the direction of the lateral sinus, in view of all the symptoms, positive and negative.

Further impressions would be only in the line of comparatively valueless speculation. The reporter cannot help sharing in the opinion that the loss of blood was conservative as regards the life of the patient.

## OTOMYCES PURPUREUS (WREDEN) IN THE HUMAN EAR.

By SWAN M. BURNETT, M.D.,

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IN an article on "myringo-mycosis aspergillina," published in No. I, vol. iv, of these ARCHIVES, Dr. R. Wreden, of St. Petersburg, relates one case which was, up to that time, unique in his experience. In my examination of the literature of fungoid growths in the ear I have not been able to find a similar one related, and as the appearances of the growth as described by him are so different from any thing yet reported, I am led to believe that it would not be without interest to place another on record.

Mr. J. H. B., 55 years of age, has had an impairment of hearing for a large number of years. He is now able on either side to hear a loud voice only at a distance of a few inches from the ear. There has been no special pain and no discharge connected with his deafness. For thirty years he has been affected with what his physician called "psoriasis inveterata," and it has involved at successive periods every portion of the surface of his body. It affected the *right* auditory meatus some years ago, but there are now no evidences of its presence there. Recently it began to trouble him in his *left* ear. There were formation of scales, itchiness, and a burning sensation. To relieve these unpleasant symptoms he poured into the meatus on that side a solution composed of

Tinct. opii	.	.	1 part
Sweet oil	.	.	2 parts
Glycerine	.	.	2 "

Within a few days after he commenced the use of his remedy he experienced some pain and a sense of heat and soreness in and about that ear ; so much so that it was not comfortable for him to lie on that side. His hearing power in that ear was at the same time diminished very markedly in clearness, and the ear had a feeling of being stuffed full of something. An inspection by means of the mirror revealed a plug of dark red, quite consistent matter, which had all the appearances of a clot of dried blood. I removed it without difficulty, by means of the syringe, and found the walls of the meatus intact, though red and rather infiltrated, and the drum-head thin and very much sunken. He experienced relief after the removal, and his hearing, though not materially improved as to distance, was more distinct and clearer.

The removed mass was then examined, and any one, on a simple macroscopical inspection, could easily have been misled into the belief that it was a dried blood-clot. On questioning the patient, however, he stated that at no time had there been any hemorrhage nor was there any ulcer or break in the skin of the meatus from which blood could have come, nor did any fresh blood follow the removal of the mass. On a more careful inspection of the walls of the meatus I found near the mouth of the canal a thinner layer of bright red substance, which was detached by means of the forceps, but whose removal was not followed by hemorrhage. This led me to make an examination of a portion of the mass under the microscope, and to my surprise I found the structure of some kind of fungoid growth, the like of which I had never seen before. Desiring to study the case further under the most favorable circumstances, I ordered nothing to be put in the ear, but sent the patient home with the request that he call in two days for a further examination. To make the clinical history complete and connected I will state here that on his return at the end of that time I found a thin layer of the same bright red substance on the walls of the meatus, but not on the *M.* This was evidently *new growth*. It was removed and laid aside in glycerine for examination. I then gave him 95 per cent. alcohol to drop in his ear, and there was no further formation of the fungus, and in the course of a week all his disagreeable symptoms of pain, heat, and soreness had disappeared. He did not wish to undergo any treatment for his chronic dry catarrh, as neither he nor I believed any material benefit would come of it.

*Microscopical appearances.*—The mycelium of the fungus is more delicate than that of *Aspergillus nigricans* or *A. flavescens*, and is septate. The fructiferous hyphens are larger and have a double contour, but are much shorter than in either of the above-named varieties of *Aspergillus*. Instead of conidia with sterigmata we have *asci filled with spores*. The walls of the asci are of double contour, but the two lines are not always parallel and vary in thickness at different parts. They are much larger, almost twice the size of the conidia of the *Aspergilli*. The *spores* with which the asci are filled are somewhat larger than those of the *Aspergilli*, and in some (the younger?) are round and without contents. Some of the asci (the older?) are of a deep red or purple color, the coloring matter seeming to have its location in the cell contents. Others are of a pale yellow color. The *free spores* differ from those contained in the asci in several important particulars. As a rule they are larger, and the greater part of them have what corresponds to a nucleus in cells. This nucleus, when it is single, usually fills more than half of the interior of the spore, and its wall is generally parallel to that of the spore. In this condition the spore is for the most part round, though there is often a tendency to a pointed elongation at one end. The majority of these free spores—particularly in the parts where the mature asci are abundant—have no prolongations. But in those parts which are apparently younger there is very often observed the beginning of what seems to be mycelium or a hyphen. In some of these free spores, too, which are larger than the others, there is observed a division of the central nucleus into two or three or more parts. In fact, a careful examination of a large quantity of the mass showed all sizes of asci, from the largest mature one to the free spore which had apparently just issued from a sporangium.

*Nowhere throughout the whole mass were any conidia or sterigmata to be seen.*

The coloring matter was by no means confined to the sporangia, but in the older portions was diffused throughout the mass; even the epithelial cells were beautifully and evenly stained by it. The appearances of the sporangia,



spores and mycelium are very well represented in the plate accompanying Wreden's paper, and to this we would refer those readers who desire to be acquainted with the microscopical appearance of the fungus.

Is this a new fungus, or is it a new form of one of those already known as having their habitat in the human ear?

Wreden discusses this question very fully in his paper, and, basing his opinion on an examination of his specimen by H. Woronin, comes to the conclusion that it is the *asceous form* of the *Aspergillus nigricans*. He says: "After I had been put in the right path by the explanations of H. Woronin, I again investigated the false membrane which had been removed from the ear, upon the supposition that perhaps some conidianiferous elements or stylophores might be found in it, which would serve to determine whether the perithecal fruit, or asci, which had been found belonged to the *Penicillium* or to the *Aspergillus*. My expectations were not disappointed. In the interior of the false membrane I found several places which were characterized by a dark, almost black color, and were readily distinguishable from the surrounding dark-red mass. I examined these spots by the aid of the microscope, and found in addition to a number of germinating spores and ripe utricles or asci, completely developed stylophores or conidia of *Aspergillus nigricans*. There can be no doubt, therefore, that in this case of myringo-mycosis the aspergillus in the ear had attained its highest form of development; for not only had conidia or stylophores been produced, but also utricles or asci had been developed. This case, therefore, is unique, and possesses all the greater interest, because heretofore the utricular form of the fructification of aspergillus, *i. e.*, spores arranged in sacs, or asci contained in a perithecium, has never been found in any organ of man or beast. *The ascomycete of the Aspergillus nigricans, that is, the highest form of the specific aural fungus, is herewith made known.*" In regard to the development of the asci, he says: "If all the external conditions requisite for perfect development are present, the mycelium first produces the stylophores and, later, when they are near the termination of their de-

velopment, asci are produced, with the ripening of which the mycelium and the entire fungus layer assumes a yellow or yellowish red color, that is, an altogether different appearance. If, on the contrary, the external conditions are only partially supplied, the development of the aspergillus will be incomplete, that is, the mycelium will produce only conidia and no asci. The converse of this, namely, the production by the mycelium of asci only, and no conidia, has never yet been found. Before the correlation of these two forms of fructification was known, they were considered organs of two widely different kinds of fungus, and the form corresponding to the ascophores was named *Eurotium*, and the other, the conidianiferous form, was called *Aspergillus*. So far the *Aspergillus* has been found in the ear of man and beast only with conidia, and never with the asci."

It will be seen from our report that nowhere did we find conidia, conidial spores, or sterigmata—in fact, there were no evidences whatever of the presence, in *any* stage, of any of the ordinary forms of aspergillus. If the *Otomyces purpureus* is, indeed, only the perfect form of an aspergillus, we should expect to find at the earlier stages of its growth the characteristic form of the *Aspergillus* fungus. Instead of cultivating the fungus on some extraneous substance, we allowed it to grow on its natural habitat for the purpose of discovering, if possible, a connection between it and one of the varieties of *Aspergillus*. We were not successful in this. We found at no stage of its growth any thing but the *Otomyces purpureus*. We are, therefore, by the process of exclusion, compelled to consider this fungus as *sui generis* in so far as it was not possible to connect its growth and development with any other form of vegetable fungus. How, then, can we account for the conidia of *A. nigricans* found by Wreden in his specimen? If it was not, as he supposes, the first stage of the *Otomyces purpureus* it must have been of accidental occurrence, which is not at all an impossible thing. There would seem to be nothing to prevent two allied forms of fungus from growing on the same ground. Not willing, however, to trust our own opinions or observations on the subject, we sent a quantity of the mass

to Prof. W. G. Farlow, of Harvard University, the highest authority on mycology in this country. He was kind enough to examine the specimen and write me his opinion of it, which I give in full:

"\* \* \* \* It having been suggested that the specimen you sent might be the ascosporic form of *Asp. nigrescens* Robin, or *Asp. flavescens* Wreden, I have made a comparison with those species. It is assumed by most botanists that the *Asp. nigrescens* of Robin is the same as the *Asp. niger* of Van Tieghen and Brefeld,<sup>1</sup> a species since placed by Van Tieghen in *Sterigmatocystis*. Of that species I have both European and American specimens of the conidia, and a specimen of the sclerotia (which are supposed to produce asci) from Rabenhorst's Fungi Europæi. I enclose a fragment of the specimen in Rabenhorst. Your specimen shows no conidia, nor, as far as I can see, any conidial spores. Certainly there are none of the echinulated spores of *A. niger*. By comparing with the specimen sent, you will see that the sclerotia sent by you do not resemble those found by Wilhelm, who furnished the specimen in Rabenhorst, to belong to *A. niger*. Although believing your fungus to be an Eurotium which in all probability has conidia which would be classed either in *Aspergillus* or in *Sterigmatocystis*—which is merely a genus of fungi differing from aspergillus in having branching sterigmata,—it seems to me that your fungus is certainly different from *A. niger* which, as I have said, is supposed to be the same as *A. nigricans* (Wreden).

"Of *A. flavescens*, said to be the same as *A. flavus* (Brefeld), I can only say that as your fungus has no conidia I have been unable to compare it directly with that of Brefeld, which I have in Rabenhorst, No. 2,155. Wilhelm describes the sclerotia of *A. flavus* as 'minuta, nigra, tuberosa.' He also says, 'Die Sclerotien sind klein und erscheinen dem freien Auge schwartz, auf der Schnittfläsche röthlich-gelb. Unter dem Mikroskop zeigt sich ihre drei bis vier, stellenweise auch mehr schichtige Rinde aus dickwandigen, lebhaft

<sup>1</sup> Wreden states (*l.c.*) that Robin had examined specimens of his *A. nigricans* and declared it distinct from the *A. nigrescens*.

dunkelbraun gefärbten Zellen gebildet. Die Zellen des Markes sind mit sehr dicken, stark licht brechenden, gelblich schimmernden Wänden versehen.'

"I have no specimen of the sclerotia or peritheca of *A. flavus*, and only know the description of Wilhelm. It is possible that your fungus is the *A. flavus*, but my specimen differs in several respects from Wilhelm's description, and I think it doubtful whether the two are identical, however. There remains the *Sterigmatocystis purpurea* of Van Tieghen, with which your fungus should be compared. I only know species from Van Tieghen's account in the *Bull. Soc. Botan. de France*, T. 24.

"In short, it seems to me that what you sent is not a form of *A. niger*, and probably also not a form of *A. flavus*. Beyond that I can only say that I am unable to connect the specimen with any known *Aspergillus* (including *Sterigmatocystis*), but that it is an *Eurotium*, either entirely new or, what is perhaps more correct, hitherto insufficiently described.

"I would remark that Woronin is an excellent botanist, and his opinion, although, as stated in your letter, different from mine, should have great weight."

Where two botanical authorities like these disagree who shall decide? As, however, only two specimens have thus far been examined and reported, we should await further investigation before forming definite theories on the subject. If it is permitted to one who is not a professed mycologist to offer an opinion, based, however, on a careful examination of one specimen, I would say that it does not seem at all probable that the *Otomyces purpureus* is in any way connected with either of the two forms of *aspergillus* which have up to this time been found in the ear. So far as I have been able to study its growth and development, it seems to assume the asceous form from the outset. As regards the various steps of its growth, further observation is required, which it is hoped some investigator may furnish ere long.

In this connection it seems to me that the variety of vegetable fungus found in the ear might depend, in some

degree, on the material supplied for its growth, as well as on the nature of the ground in which it takes root. How far the psoriasis and the particular mixture which the patient put into his ear influenced the kind of fungus growth we have had under consideration, is a question of no inconsiderable practical as well as scientific interest, and experiments and observations in that direction are highly desirable.

## EXOSTOSES OF THE EXTERNAL AUDITORY CANAL.

BY S. C. AYRES, M.D., CINCINNATI.

THE study of exostoses of the external meatus is one of interest to the aurist, although not of much practical importance in every-day practice. They are seen so rarely that they may be classed among aural curiosities. In looking over cases reported in books and journals there seems to be a good deal of uniformity in their development. They may spring from any portion of the canal, but preferably from its posterior wall. They also arise from its upper as well as its lower wall. A number of cases are reported where two and even three exostoses are found growing from different portions of the same meatus. We also find both ears of the same individual symmetrically affected.

If we may judge from the examination of the crania of some prehistoric nations and from the cases we see in ordinary aural practice, we might justly conclude that the disease in question had been much more common in ages gone by than it is at the present time. Dr. Clarence J. Blake, of Boston, in vol. 2, *American Journal of Otology*, Part II, gives the results of examinations made by him of one hundred and ninety-five crania taken from the mounds of the Cumberland Valley, Tenn. In eighteen per cent. exostoses were found in one or both canals. He also examined one hundred and eight California crania and found five per cent. similarly affected. He made a further examination (vol. 2, Part IV) of thirty-seven crania from the mounds of St.



Francis River, Arkansas, and found seventeen per cent. with exostoses of the external meatus.

Dr. F. W. Langdon, of this city, in a recent paper on the Madisonville Prehistoric Cemetery, reports his examination of eighty-three crania in five of which he found bony growths in the canal. In three of these cases the exostoses were limited to one side, and in the other two they occur in both ears. In one skull the meatus is so obstructed by these growths that its lumen is quite obliterated on one side and nearly so on the other.

A few years ago Prof. Seligman made an examination of American skulls in European collections, and discovered that exostoses of the external auditory canals must have frequently occurred among those nations where the head had been elongated by pressure during infancy.

It would seem from examinations made so far that the prehistoric races and the Indians and their progenitors were more frequently affected with these bony growths than are the Europeans or Americans of the present day.

So far as my personal observation goes I should say that exostosis of the external meatus was rare in this country. Among a large number of aural patients I can now recall but four cases. In three of them there was a single bony tumor growing from the wall of the meatus, and in the fourth case there was complete closure of the canals with an ivory-hard bony septum.

CASE 1.—My first case was a medical gentleman, Dr. K., who was aware of a bony growth and called my attention to it. It was a rounded bony protuberance springing from the posterior wall of the meatus. It almost closed the lumen of the meatus. He had been aware of its presence a number of years, and was occasionally annoyed by cerumen and epidermic scales filling up the almost closed passage. He writes me that he thinks it has grown slowly during the last ten years.

CASE 2.—Mr. B., 22, a healthy, well-developed man who had never suffered from any ear trouble, suddenly became deaf in one ear. Examination revealed the presence of a large exostosis growing from the posterior wall of the meatus. The space between the growth and the walls of the meatus had become closed

with cerumen, and marked deafness followed. He could hardly believe that the growth had been there several years and possibly was congenital. He went abroad for further advice and consulted Profs. Politzer and Moos.

CASE 3.—Mr. A., aged 30, has an exostosis springing from the lower and posterior portion of the meatus. It partly fills the canal, but in other respects gives him no trouble. He had a middle-ear catarrh but never had any discharge.

In neither of these cases is there any history of previous aural trouble accompanied with an otorrhœa.

CASE 4 is one of special interest, as the characteristics are quite different from the others. Mr. H. A. C., aged 28, a healthy and powerfully-built man who had always enjoyed excellent health, gave the following history in brief :

He had scarlet fever when about five years old, which was followed by chronic suppurative inflammation of both middle ears, which continued for several years. At times the discharge was scant, and at others, profuse, bloody and very offensive. The otorrhœa continued in the right ear till 1866 when it ceased, and in the left ear till 1873. His hearing has been variable; at times moderately good, and then again duller. Since the cessation of the discharge his hearing has gradually grown worse. His hearing distance in the right ear was  $\frac{1\frac{1}{2}}{80}$ " , and in the left ear  $\frac{1}{80}$ " . He could hear ordinary conversation carried on with one person tolerably well, but mingled voices confused him very much. Examination of the meatus revealed the fact they were occluded with a bony septum. The septum in each was about half an inch from the posterior border of the cartilaginous canal. The external surface of both was concave and covered with epidermis. The central portion appeared whiter than the periphery. Pressure with a probe showed that the surface was quite smooth. It was somewhat sensitive to pressure, but not more so than the ordinary exostoses which spring from the walls of the meatus.

Upon inflation of the middle ear he was aware that air entered the ears, but whether it impinged on the drum membranes or on the bony septa it was impossible to determine. No improvement in hearing, however, resulted.

He was anxious for relief if it could be given, and the question of surgical interference became one of the greatest importance.

The literature on the subject at my command furnished only one similar case, that of Bonnafont (*Monatsschrift für Ohrenheilkunde*, vol. ii, No. 8), which had been operated on. It was perforated with a rat-tailed file and remained open several years. In all other cases operated on the histories distinctly stated that the growth sprang from some portion of the wall of the meatus and encroached upon the opposite wall and thus threatened complete closure.

The case of Dr. L. B., of Hamburg (*Archiv für Ohrenheilkunde*, vol. x, p. 110), operated on by Dr. Knorr, is one of this kind. The brilliant and successful case of Dr. Mathewson, of Brooklyn, where he used the dental engine, is another one where the growth was extending across the meatus and was likely to result in its complete occlusion if not in something more serious. Here was a case with both canals closed with a bony growth, and where some surgical interference seemed entirely justifiable.

I decided to adopt Dr. Mathewson's plan and try the dental engine on the left ear, which was the poorer one. I applied to Dr. W. S. How, of this city, a very skilful and ingenious operator, for his assistance. I selected some drills, and Nov. 29, '80, with the assistance of Drs. E. Williams and Sattler, I made the first attempt to perforate the septum. The skin had been previously removed by the use of chromic acid, so that the drill came directly upon the bone. Dr. How managed the dental engine, and with a forehead mirror I was enabled to illuminate the meatus. Mr. C. preferred not to take an anæsthetic, so that we had to proceed slowly on account of the pain. I soon found that the shank of the drill was too short and that the drill itself wobbled too much, not being firm enough in its socket. But little progress was made, and it was soon decided to wait a few days and have some other drills constructed. There was but little hemorrhage. The growth was *extremely* hard,—in fact, as hard as ivory,—and the drill seemed to make but little impression on it.

*Dec. 4th.*—We made another attempt with the new drills which had sufficiently long shanks to enable one to see the point of the drill while it was in contact with the bone. He stood the operation very well, but as it necessarily proceeded slowly on account of pain it soon became unbearable, and he asked us to desist and he

would take an anæsthetic some other time. But little reaction followed, and a few days later we attempted to complete the operation under the influence of an anæsthetic. Ether was first administered, but it was impossible to anæsthetize him completely. He became wild and unmanageable, and it acquired our combined strength at times to hold him. Chloroform was resorted to, and while it did better, yet it did not act kindly. When he became profoundly anæsthetized, threatened asphyxiation came on and we had to desist. I improved every moment of quiet which he had to go on with the drilling. It was extremely difficult with such an unmanageable patient, for I was now nearly through and was afraid of doing some damage to the middle ear in case I perforated suddenly. At last I felt the drill perforate, and could have enlarged the opening with larger drills, but the patient had now been under the influence of the anæsthetic about twenty minutes, and was so wild and unruly we thought it prudent to stop.

There was some hemorrhage from the meatus, but it soon ceased. Some suppuration from the external ear followed, which continued for several days. The bony septum was now exquisitely sensitive, but with a probe I could see that it was about 5 *mm.* thick. His hearing distance was slightly increased and made equal to the right ear. He had to leave the city a few days later, but a letter dated Jan. 12, '81, stated that the suppuration had ceased and that his hearing distance was as good as when he left the office.

I felt that it was only the part of prudence to move cautiously in such a case, not having a similar one to judge by.

In exostosis from the wall of the meatus the supposition is that there is a drum membrane behind it, and this is demonstrable in most cases, and it is not difficult to estimate about how far one would have to drill. In this case, however, these points were not clear. It was not certain that there was a drum membrane at all, and the bony septum was so deep it was difficult to reach it with a drill and at the same time regulate its effects. There was constant danger that the sudden and violent movements of the patient as the drill neared the opposite side would cause it to do some damage to the middle or possibly the internal ear.

Exostoses are either congenital or acquired. How many

are really congenital it is impossible to say. There may be many irritating causes in infancy and childhood,—furuncles, suppurations, injuries, etc., which may furnish the nucleus for the future but very gradual development of the growth, and it is possible that this growth may cease with the development of the system and remain stationary. Early troubles in the ear are often forgotten or overlooked by the parents, and consequently unknown to the children, so that the histories of cases are likely to be imperfect.

Dr. Burnett in his excellent work on Diseases of the Ear, p. 320 (1877), reports a case very similar to that of mine. It is one of acquired bony occlusion of the external meatus with a previous history of suppuration and development of polypus.

In Toynbee's work (2d Am. ed., p. 145) he gives a wood-cut of a case where the auditory canal is nearly closed with a bony development. He first saw the patient in June, 1847. He then had a polypus which nearly filled the canal. It was removed; the discharge ceased and did not return for ten years. In July, 1857, the patient again presented himself, complaining of a slight discharge from the ear. On inspection the canal was found almost filled with a bony growth which had so far closed that now only a small triangular opening remained.

In Dr. Mathewson's case there was a history of pain in the ear until she was eleven years of age, but without discharge. Since then she had had a sense of fulness in the ear.

In the case of Dr. L. B., of Hamburg, he did not discover the growth until he was forty-three years of age, so that there is a fair presumption that it may have been congenital, as he had had no discharge. It had never given him pain previous to the time he discovered it. His attempt to remove the supposed foreign body from his ear caused some inflammation which subsided, and he experienced no further trouble for four years, when he became aware that the exostosis was increasing in size. What relation the previous inflammation had to the subsequent growth of the exostosis must remain an undetermined factor in the case.

Prof. Moos, of Heidelberg, in vol. viii ARCHIVES OF OTOL-



OGY reports a case of closure of the auditory meatus and loss of hearing by the formation of exostoses. The patient had never had any disease of the ear, but became totally deaf on the right side within two days. Examination revealed "a large globular exostosis (*a*) springing from the posterior wall of the ext. aud. meat. and completely filling its whole calibre. This exostosis bears on its upper circumference a second smaller one, resting upon the larger with a broad base, and running somewhat to a point in the direction toward the upper wall of the meatus. Its surface is dull-white, while the cutaneous envelope of the large exostosis appears red and thickened. The gap which the large globular exostosis still leaves open in front and upward is filled (*b*) by a more club-shaped exostosis running toward the anterior and upper one in a circular direction, with its thinner portion extending downward and its thicker portion upward; between this and the anterior upper surface of the large globular exostosis is a small hollow, through which, however, it is impossible to penetrate any deeper inward with the probe. The cutaneous envelope of *b* resembles that of *a*." He considered it a case of *acute closure* of the ext. aud. meat. due to the presence of bony excrescences.

An expectant plan of treatment was adopted. Rods of laminaria were introduced. Their presence caused violent pain and excited a growth of granulations which were removed by the snare and the galvano-cautery. In the course of treatment there occurred a perforation of the drum membrane. About two months later the inflammation had subsided and the discharge ceased, and he states that *the anterior exostosis had disappeared*. In the space above the large exostosis the anterior upper quadrant of the memb. tymp. could be seen.

The hearing had greatly improved, being now almost equal to that of the other ear. Prof. Moos attributes the destruction of the exostosis *b* principally to the effects of the galvano-cautery.

A remarkable case of exostosis in the ear is reported by Dr. Hedinger, of Stuttgart, in ARCHIVES OF OTOTOLOGY, vol. x, No. 1. He says that the chapter of the exostoses is



still rather dark—their pathogenesis being as yet entirely unknown. He finds the new formations frequently associated with chronic tubal catarrh or suppuration. In the case in question there was great swelling of the mastoid process with forward and outward displacement of the auricle.

“The meatus was filled with a hemispherical, immovable new-formation of osseous consistence, starting from the upper and posterior wall of the auditory meatus.” Rods of laminaria were daily introduced into the canal with most satisfactory results. The mastoid complication necessitated a free Wilde’s incision, which gave exit to a large amount of retained pus. He removed a small piece of necrosed bone from the lower wall of the auditory canal, and by the use of the chisel obtained several small particles from the lower third of the tumor. After a microscopic examination of these he makes a diagnosis of “inflammatory proliferation of the papillæ and of the connective tissue, with deposition of lime within it (osteoid metamorphosis).”

At the International Medical Congress held in London last August<sup>1</sup> the question of morbid growths within the ear was freely discussed by the section on Diseases of the Ear. An exhaustive paper on the Etiology of Aural Exostoses was read by J. Patterson Cassells, of Glasgow.

In his judgment exostosis is nearly always complicated with another affection of the ear, past or present; while hyperostosis may exist in the meatus with normal hearing. For the removal of the former he recommends the gouge, and for the latter the dental engine.

Dr. Guye (Amsterdam) had seen a case of multiple exostoses united by an osseous bridge, which he removed, and Dr. Loewenberg (Paris) a similar case, where he had resorted to the galvano-cautery. Dr. Knapp, in one case, had successfully used the chisel.<sup>2</sup>

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<sup>1</sup> Compare on this subject two recent papers: DELSTANCHE fils, *Contributions à l'étude des tumeurs osseuses du conduit auditif externe*, Bruxelles, 1879; and A. LUCAS, *Removal of exostoses in the ear canal*, *Arch. f. Ohr.*, xvii, p. 246.—ED.

<sup>2</sup> (See Report in these ARCHIVES, vol. x, p. 297, etc.)

## CLINICAL CONTRIBUTIONS TO OTOLOGY.

BY C. R. AGNEW, M.D., AND DAVID WEBSTER, M.D.,  
NEW YORK.

CASE I.—*Binaural deafness, probably due to simultaneous exudations into both labyrinths.*

Joseph R., æt. 40, came under observation December 14, 1874. The following letter which he brought with him from his family physician, Dr. John Messenger, contains important facts in the history of his case.

"The patient, Mr. J. R., came to consult me July 6, 1874. He was then, and had been, living on Eightieth Street, a little west of Broadway, in a frame house, rather old, and surrounded with a growth of shrubbery, fruit-trees, vegetable garden, etc. He and his family had resided there for several years, and all had had good health up to the time when Mr. R. was attacked (July, 1874) with a severe ringing sound in the ears, which came on suddenly without pain or severe general or local distress. There was quite a severe nervous derangement, if I may so term it. He was very weak and depressed. Deafness, almost total, was a symptom from the first. A loud and rather base sound was not heard as well as a sound of high or acute pitch. The shutting of a door, or something falling on the floor and making a shrill noise would startle him, and make him start up in a fright. A very careful survey of his person, ocular inspection, palpation, auscultation, analysis of the urine, chemical and microscopical, the constant and interrupted currents of the faradic and galvanic batteries, all failed to indicate the locality of any diseased structure. Malaria came in for a share in the cause of the trouble, but there, too, I failed in my efforts to convict the offender. He is a man of good, temperate, regular habits, and always has been so."

Mr. R. gave me the following account of the way in which his trouble was ushered in. About the first of July, while riding down Broadway in a horse-car, he thought he heard a fire-bell ringing, and said so to his wife. She replied that she heard nothing of the kind. Presently he heard the bells ringing again, but as his wife did not hear them he was forced to the conclusion that the sounds originated in his own ears.

These sounds, with many variations, have persisted in the most distressing and annoying manner ever since. During the summer, while sitting in his garden, noises of bats, owls, and frogs were repeated in his ears. Again the most furious steam-pumping sounds would be heard.

The hearing of both ears was impaired from the first, but he was able to hear conversation for several months. The hearing of the right ear was very gradually lost first, and that of the left went in the same way a few weeks later. He had been unable to understand spoken words for three or four weeks when he first came under our observation. He never lost the power of hearing certain external sounds, such as his parrot saying "cuckoo." He is very nervous, certain noises going through him like an electric shock. His voice is somewhat raised in pitch, and not under good control. The tuning-fork is heard very faintly when placed in contact with his teeth. So far as could be determined by inspection his external and middle ears were normal. His Eustachian tubes were easily opened.

It was believed that the symptoms pointed to disease of both labyrinths, the result, perhaps, of some obscure intracranial disease. An unfavorable prognosis was given, and the patient was placed upon a mixture containing iodide of potassium, bromide of potassium, bromide of ammonium, and sesquicarbonate of ammonia. Mercurial inunction was also used, and was carried to the point of slightly touching his gums. He was afterward treated with increasing doses of nitrate of strychnia, administered hypodermically, and by large doses of quinine. Electricity was applied to his Eustachian tubes and external auditory canals, both constant and interrupted currents, but all without appreciable effects.

On January 4, 1875, I tested his hearing with my watch and was surprised to find that he could hear it with his right ear at a distance of six inches ( $\frac{6}{80}$ ), and with his left at eight inches ( $\frac{8}{80}$ ). I repeated this test at different visits afterward, and found that his power of hearing the ticking of my watch varied, the farthest

point at which he heard it any time being fifteen inches ( $\frac{15}{8}$ ). The test of his power to hear the watch was repeated and confirmed by Dr. Agnew.

We saw Mr. R. again more than a year afterward (March 15, 1876). He said that in about a month after the date of his last visit the subjective noises almost entirely disappeared, and that since that time he has been free from tinnitus, except during mental excitement, when he hears one, two, or three sounds like the blows of a hammer. The stronger the excitement the longer these sounds continue. He hears the watch pressed against the right ear, and at a distance of two inches from the left ear. He hears the sound of his own voice and controls it better than when I first saw him. He says he has had much domestic trouble since he stopped treatment, and has used tea, coffee, and beer freely, and to this he attributes his not hearing the watch so well as formerly. We placed him near a piano, with his eyes closed, and struck all the keys in succession. He heard a sound when *a* and *d* in the highest octave, *f* in the lowest octave, and *f* in the next to the lowest octave were struck, but not every time. He counted correctly every time the strokes on a tumbler with the back of a jack-knife blade, with his back turned, at a distance of twenty feet.

Mr. R. states that he had a fall on his head during the fire at the Fifth Avenue Theatre, about a year before his ear trouble set in, but he does not think that was the cause of it. His residence was in a malarious district, but he thinks his deafness may be more directly due to his long and arduous labors in a new and damp painting-room, where he frequently spent fifty hours without intermission.

This patient never had venereal disease of any kind. It will be noticed that he at no time suffered from vomiting or from vertigo. It seems extremely improbable that the disease began in his ear drums. An attack of otitis media so sudden as this, and severe enough to produce such damaging results, could scarcely occur without pain, more or less severe, and this patient never had an earache, and not even well-marked headache, his main symptom, aside from deafness and tinnitus, being intense nervous irritability. Moreover, his drum-heads were normal, on inspection, when we first saw him, nearly six months after the disease was ushered in. There can be little, if any, doubt, then,

that it was an affection of both internal ears. Perhaps we may be permitted to go a step further, and venture to express an opinion as to the character of this affection. All the symptoms in the case would be accounted for by the hypothesis of a simultaneous hemorrhage, or a simultaneous exudation, occurring in both labyrinths. Reported cases of hemorrhage into both labyrinths have usually, if not always, been the results of traumatism, as falls or blows upon the head. But we see no reason why apoplexies may not occur in both labyrinths as well as in both retinae simultaneously, and we do occasionally meet with cases of the latter without any assignable cause save changes in the walls of the blood-vessels. But in the case reported above, the theory of a labyrinthine exudation seems to me the more probable one. Mr. R. seems to have been surrounded by the most favorable circumstances for "taking cold." May he not have "caught cold" in that "new and damp painting-room where he frequently spent fifty hours without intermission"; and may not that "cold," which in one man would have produced a pneumonia, and in another an otitis media, have produced in Mr. R. an inflammation of his auditory nerves, or an "otitis labyrinthica" of both sides?

The fact that the patient could hear the watch readily at a distance of several inches while totally deaf to conversation is very remarkable, and we can only explain it by supposing that the exudations which occurred in both labyrinths were plastic rather than serous, and produced pressure upon certain areas of the terminal fibres of the auditory nerve, while other portions were left comparatively free from pressure.

CASE 2.—*Wound of the membrana tympani by an oak stub.*

Dec. 21, 1875. C., æt 36, stated that four days ago, while out hunting, in the act of mounting a fence, he fell and thrust an oak stub into his right ear. Slight bleeding occurred, with immediate deafness. A bloody discharge soon occurred, with deep pain in and around the injured ear. The hearing distance is now: watch, right ear, 8 inches; left ear, 16 inches. The tuning-fork placed on the forehead is heard more distinctly in the right ear.

Inspection shows an opening through the membrana tympani below the end of the handle of the malleus.

Some pieces of bark and dirt were washed out of the ear by syringing with warm water. The middle ear was gently inflated three times a week by Politzer's method, and in the course of three weeks the perforation healed with little or no impairment of hearing.

CASE 3.—*Double rupture of the membrana tympani from a blow.*

Jan. 27, 1875. Mrs. N. H., æt 37, says that four days ago she received a blow of an open hand on her left ear. A noise like the roaring of the sea came on immediately, and has continued ever since, but is gradually growing less distinct. She has had absolutely no pain in the ear since that passed away which was the immediate effect of the blow, and she has not noticed any deafness. There has been no discharge from the ear. Her hearing for the watch was found to be acute and equal in both ears, nor was there any difference in the ears by the tuning-fork test.

Upon looking into the injured ear we found that there were two ruptures of the drum-head distinctly visible. One was situated in front of the handle of the malleus, was nearly parallel with it, and extended about two thirds of its length. The other extended from the end of the handle horizontally backward nearly to the periphery of the membrane. The air passed through both these openings readily when the ears were inflated by Valsalva's method. The drum-head was reddened and slightly swollen.

The patient was treated on the expectant plan, nothing being applied except, on one or two occasions, the warm aural douche to allay irritation, and the ruptures healed in the course of a fortnight, leaving almost invisible cicatrices. When the patient was last seen the hearing was unimpaired and the roaring had entirely passed away.

CASE 4.—*Supposed foreign body in the tympanum.*

August 5, 1874. C. G., æt. 3, came to his mother five days ago and asked for a pin, saying he had got a stone in his ear which caused pain. There was some dirt seen in the meatus. His father passed a darning-needle and "sounded" the external auditory canal and "struck something." The child was then taken to the office of Dr. D., who syringed the ear with warm water and got out some earthy matter, after which he introduced a blunt probe and felt a substance low down in the canal, filling the cavity so that he



could not pass the probe beyond it. It sounded "gritty." He then placed the child under ether and tried to pry it out. He did get hold of it, but could not pull it out with his forceps. The child was then taken to Dr. E., who probed the ear, used the ear-spoon and ear-forceps without extracting the foreign body. Yesterday morning he gave an anæsthetic and broke away a piece of bone, but still failed to remove the foreign body. Some paresis of the seventh nerve occurred early in the manipulations. Examination now shows what seems to be a foreign body pushed through the membrana tympani and stuck immovably in the middle ear.

We syringed the ear freely and then advised to desist from further active interference as a choice of evils, believing that we could not remove the supposed foreign body by any means that we were willing to employ, and hoping that at a later stage the discharges might dislodge it. Indeed, the parts were so altered by the lacerations occasioned by the attempts to remove the supposed foreign body that we could not say positively that any existed in the middle ear, but feared that the bony wall of the middle ear had been so denuded and broken as to beget the appearance of a foreign body.

In this connection it may be well for us to say what we believe to be the proper line of treatment to be pursued in such cases. When a foreign body is lodged in the external auditory canal the first means to resort to for its removal is syringing with warm water. We should use for this purpose a syringe having a large barrel and small nozzle, and endeavor to throw the stream of water not against the foreign body but the wall of the canal, so as to press past the foreign body and thus to discharge it by the recoil of the water.

If syringing does not discharge the foreign body the patient should be put profoundly under ether and very careful attempts made by the use of instruments to accomplish the object. A very thin steel scoop, or the Daviel spoon, is the best instrument for the purpose, and this should be gently insinuated between the foreign body and the wall of the meatus, while the body is held by a hook, like the cystotome used in cataract extraction, from pressing inward against the drum-membrane.

If bleeding occurs time must be allowed for it to cease, otherwise the proper direction of instruments cannot be preserved.

It is possible, also, to pass a delicate sickle-shaped knife down through the skin of the meatus, past the foreign body, and use it as a vectis after its point shall have been passed beyond the foreign body, care being exercised not to push the body deeper into the canal. No one, however, should attempt such operations unless he is familiar with the anatomy of the parts, and understands the methods of examining the ear sufficiently well to *see the foreign body* he is attempting to extract.

In practice, the syringe is usually effective unless meddlesome and clumsy interference has pushed the body down upon, or through, the membrana tympani.

Forceps are not available. When the foreign body fills the canal they cannot be applied, and in all cases where they can be applied the syringe will do the work, and with less danger to the organ.

In all cases the greatest care must be exercised not to press the foreign body deeper into the canal, and not to attempt to dislodge it with any instrument that does not pass between it and the wall of the canal.

No harm can be done by passing an instrument through the skin of the meatus, provided the operator really knows the depth of the canal and, by the exercise of the "learned touch," can tell when the distal end of his instrument has gone beyond the foreign body.

Cases 2 and 3 are given, not because they exhibit any striking novelty, but because their histories seem to prove that the best results in practice are often reached by the absence of what is called, and very properly, *active interference*.

ON THE OCCURRENCE AND THE SIGNIFICANCE OF  
COCCOBACTERIA IN PURULENT OTORRHŒA, WITH  
REMARKS ON THE TREATMENT OF CASES IN  
WHICH THEY ARE PRESENT.\*

BY DR. B. LOEWENBERG, PARIS.

Translated by JAMES A. SPALDING, M.D., Portland, Maine.

PART II.

PATHOLOGY.

THE external auditory meatus, amongst all the cavities of the human body, is the most suitable camping-ground for those micro-organisms which are incessantly blown to and fro by the constant currents of air about us. To these minute corpuscles its orifice must seem an immensely wide opening. When they once touch the sticky walls of the meatus they cling very firmly, gradually collect in its blind and pouch-like cavity, and usually remain for a long time entirely undisturbed, simply because the deeper portions of the meatus are exceedingly sensitive to all attempts at cleansing.

*If now a fluid secreted in the tympanum during an attack of acute otitis media is effused into the meatus through a rupture in the Mt, it becomes at once exposed to all those influences which favor putrid decomposition.* Microphytes of the most various types, or their germs, are present, the fluid stagnates, the meatus is warm; what better soil then could we have for the development of schizomycetes? Moreover,

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\* *Conclusion.*—Compare previous number of these ARCHIVES, page 220.

the serous or purulent discharge contains albuminous bodies, salts, and an abundant amount of moisture. Hence, in connection with the acid ingredients held in suspension in the air, which always has free access to the meatus, we find a perfect combination of all the materials necessary for the luxurious nourishment of these micro-parasites, as we have already demonstrated in the preceding chapter. It would be indeed astonishing if these putrefactive organisms were not developed under such favorable circumstances as these.

We must, however, insist upon the fact that these organisms are not confined exclusively to the meatus, but are pushed onward into the tympanum by syringing or by the instillation of lotions. Sometimes they fall deeper into the meatus by simple gravitation, whenever the patient lies upon the healthy side. Even the luxuriant multiplication of schizomycetes is sufficient to push the gelatinous envelope further on toward the tympanic cavity. I have seen many cases which proved beyond a doubt that cocci really pass beyond the *Mt*, for, after the most scrupulous purification of the meatus, I have once more driven air through the perforation with Politzer's bag, forced out pus, and found within it a bit of the gelatinous envelope. Moreover, I am firmly convinced that the gelatine is frequently found in the regions adjoining the tympanum. The structure of the petrous bone, with its numerous fissures and cavities, offers a superabundance of recesses in which the secretion, protected from every thing but the most careful cleansing, can stagnate undisturbed and degenerate into a perfect condition of putrefactive decomposition.

This condition of things in the middle ear is not to be regarded as an accidental and insignificant contamination by schizomycetes, but a definite *settlement* and rank development of these micro-organisms in this region. This is proved by the constant occurrence of the more highly developed and pathologically important forms of the coccus-gelatine (Zoöglea).<sup>1</sup>

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<sup>1</sup> This paper will refer to micrococci alone, no attention being paid to the rod-bacteria, which are by no means rarely observed.

We may take it for granted that acute inflammation of the middle ear is almost invariably followed by a much more frequent and persistent suppuration than in any other part of the body. Indeed, the fact is so common that we take it as self-evident without troubling ourselves to think of the strangeness of such an occurrence, the key to which, in my opinion, lies in the fact that here, more than in any other region of the body, all the conditions for the development of schizomycetes appear realized in a so to speak, ideal perfection. The germs of schizomycetes capable of propagating themselves are always found in the micro-organisms stored away in the meatus. Whenever they multiply under these favorable circumstances, they manifest the same influence which they always exert upon wounded surfaces, preventing recovery by first intention, causing and maintaining suppuration.

The pathological importance of these micro-parasites is, however, by no means exhausted with this account of their influence in disturbing the normal processes of repair. On the contrary, they may induce a much more critical state of affairs. When we give our chief attention to one of the most frequent complications of otitis media, *inflammation with collection of pus in the mastoid process*, it seems very plausible to assume that this condition may occur in the cavities of this bone by simple propagation of the morbid process by continuity and contiguity. In the same way we can assume as another cause, some obstacle to the escape of the secretion, such as a closure of the communication between the antrum and the tympanum by polypi, etc. Still, when we consider how often pus is found in this region in a condition of *stagnation* and putrefaction, we cannot but think that putrid decomposition of the secretion can occur in this locality and subsequently induce violent local or even general constitutional disturbances.

The same may be said of *caries and necrosis*. It is plain that the inflammation and formation of pus can extend directly from the periosteum to the bone itself, while we have an additional cause for the affection of the osseous substance proper in the development of decomposition fungi.

For we know since the publication of Klebs' <sup>1</sup> investigations into mycosis septica<sup>2</sup> that the cocci which flourish upon the granulating surfaces of old abscesses, fistulous canals, surfaces of joints, etc., can loosen the tissues and cause defects of substance. It is quite probable that the ulcerations upon the mucous membrane of the tympanum in chronic otorrhœa originate in this manner, and that the bone itself may subsequently become affected. Several causes might operate in bringing about this last condition of things which is still obscure in its finer details. If we grant that the schizomycetes cannot directly dissolve the osseous tissue, yet we may agree with Klebs that these organisms may affect this tissue by mere mechanical action, despite the fact that they cannot enter the osseous canals. I am also further inclined to think that the soluble acid substances which are formed during the development of schizophytes and the simultaneous putrefactive decomposition of albuminous bodies when plenty of air is present, are capable of dissolving at least the carbonate of lime in the bones. And,

<sup>1</sup> Edwin Klebs: Beiträge zur Pathol. Anat. der Schusswunden. Leipzig, 1872, p. 104, *et seq.*

<sup>2</sup> Great confusion seems to exist in the daily increasing literature on micro-parasites, owing to the fact that the word "mycosis" is used for the most heterogeneous things. Thus, for example, we comprehend under this title the diseases caused as well by the hyphomycetes as by the schizomycetes, and yet we know that there is a very wide difference between these two classes, as well in reference to their influence upon the organism, as to the conditions necessary for their existence, their chemical reaction, etc. Parenthetically, it may be mentioned, that by "mycosis" we also designate a body discovered by Mitscherlich in the ergot, as well as an affection of the skin, which, so far as I know, is not of a parasitic nature at all.

It seems urgently necessary in the interest of scientific exactitude that we should thoroughly sift this terminology, at least so far as concerns the diseases caused by schizophytes on the one hand, and by mucedineæ on the other, that we should divide them into two sharply defined classes and provide them with special and characteristic titles. I propose, therefore, to continue for the affections caused by mucedineæ or hyphomycetes (*aspergillus*, *penicillium*, etc.), the name mycosis, and to use for those originated by the schizophytes, the new name SCHIZOSIS (from *schizo*-mycetes).

I am convinced that in this way we shall be able to avoid all misunderstanding, which was previously a matter of great difficulty.

I would even go further and express the desire that especial titles could be created for the various groups of diseases caused by schizomycetes, *e. g.*, coccosis, bacteriosis. We might entitle those aural affections chiefly due to schizomycetes, "otoschizosis;" those due to cocci, "otococcosis," etc.

I cherish the hope that this nomenclature may be as unanimously accepted as was the title which I proposed in 1866, of "Corti's pillars." (See B. Loewenberg: "La lame spirale du limaçon et l'organe de Corti. *Journal d'Anatomic*, etc.)



moreover, we know that where osseous tissue which has resisted putrefaction for thousands of years is at last deprived of its calcareous portions, it at once yields to decomposition like all other tissues.

It is a fact that the coccus-gelatine can destroy the *periosteum*, so that the bone is laid bare and its blood supply from the outer surface cut off; in other words, necrosis can ensue. Since many chronic periosteal affections are but slightly painful, we may even see them lead to the formation of sequestra without any complaints on the part of the patient of disagreeable subjective sensations. So far as concerns the *ossicles of hearing*, I would say that they may be exfoliated in a condition which is far removed from a necrosis, for their articulating surfaces (schizomycetes can dissolve cartilage) and connective-tissue ligaments can become corroded, and disappear, so that all support is taken away and the bones drop from the meatus.

The inflammation and suppuration may advance and finally occasion *disturbances of the most serious nature in those organs which adjoin the petrous bone, as well as in those at a distance*. Thus we may observe meningitis (with or without perforation of the intervening petrous bone), phlebitis with corrosion or formation of thrombus in the adjacent sinus or internal jugular vein, or ulceration of the internal carotid, etc., all of which accidents are really to be regarded as a simple extension of the morbid process.

In contradistinction to these cases we observe others in which we find thrombi in the sinuses which are separated from the diseased bone by healthy tissues, or in which abscesses exist in portions of the brain provided with a normal cortex, or, finally, cases in which meningitis occurs only on the convexity of this nerve-centre. In such cases as these, we attempt to lift ourselves over the gap by embracing the opinion that the inflammation must have extended along the connective-tissue fibres and vessels, despite the fact that this view is evidently insupportable when we consider the normal condition of the parts which lie between the petrous bone and these organs (brain, etc.).

In opposition to this hypothesis, the proof of the occur-

rence of micrococci in purulent otorrhœa seems to offer a key to the correct significance of these complications, which are as dangerous as they fortunately are rare. We have already seen that innumerable and luxuriant cocci are present in all cases of otitis media purulenta, and *it is even more than probable that the morbid process is spread to a distance by the migration of these micro-organisms*. Inasmuch as they are absolutely incapable of self-motion (the pretended movements of cocci are simply molecular movements) they may be transferred from place to place by the agency of the *migratory cells*, into which they easily penetrate, and even into the fissures in the looser connective tissue, or into the sheaths of the blood-vessels. If this be true, we now see why they do not cause any symptoms whatever while on their pilgrimage, and only begin to act deleteriously when they meet with some impediment in the substance of the brain, where mechanical or functional causes lead to their colonization. This is the manner in which I explain the occurrence of those cerebral abscesses which show no visible connection with an existing affection of the middle ear, as well as meningitis without any connection with the inflammation of the tympanum, and so on for the other unexplained complications which have previously been mentioned. An observation by Klebs (*l. c.*, p. 110) is valuable in so far as concerns meningitis, for according to this the microspores from clumps of pus can penetrate through the tissues into the neighboring serous cavities, and even after the disappearance of all local irritative phenomena give rise to new inflammation and suppuration.

It is well known *that death occurs, during many cases of otorrhœa, under pyæmic or septicæmic symptoms*, without visible caries of the petrous bone or palpable alterations in the adjoining organs. In these cases, likewise, the mechanism by which local suppuration leads to constitutional infection is easy to understand, when we reflect upon the putrefactive processes going on in the tympanum and adjacent cavities. We prove that schizophytes penetrate the walls of the lymphatics, and even of the blood-vessels, in company with migratory cells, and we are safe in assuming that metastasis

into the lungs is caused by cocci swept into the circulation alone or in company with thrombi. Nevertheless, I am unable to say what part is taken in this process by *that toxic material which is formed during the decomposition of albuminoid corpuscles*. I would therefore recommend an examination of the blood from the living patient, in order to demonstrate the propagation of micro-organisms, and careful study of the course of the general constitutional symptoms, since poisoning by albuminous matter undoubtedly causes death more rapidly than an invasion of all the blood in the system by the parasites.

v. Troeltsch<sup>1</sup> gives an excellent description of the septic complications in purulent inflammation of the middle ear, and expresses the opinion "that the *septic gases* exude through the thin walls, which are usually composed of but a single membranous layer, and irritate the neighboring structures into a condition of putrefaction." I would like to modify this theory by suggesting that the gases do not infect the tissues, but render them more receptive to micro-organisms.<sup>2</sup>

The chief circumstance which fortifies me in the opinion that all these complications depend upon putrid decomposition is that they always occur in *old, chronic* otorrhœas, in which the development of putrefactive organisms is so wonderfully favored by the stagnation of pus in the cavities communicating with the tympanum. The fact itself is one which I discovered after carefully examining many cases recorded in literature, in which, so far as concerns the older ones, I made extensive use of the rich collection of Gintrac.<sup>3</sup> It is further remarkable how often aurists speak of the foetid odor as well as of a putrid secretion in such cases. If we do not find this mentioned in the cases communicated by

<sup>1</sup> Lehrbuch der Ohrenheilkunde, 1881, 7te Aufl.

<sup>2</sup> Compare Wernich, "Grundriss der Disinfectionslehre." I take this opportunity of yielding to this author of so many interesting papers on schizomycetes the priority in the discovery of the heating of cotton plugs for bacterioscopic cultivation, for I find by the above work, which reached me after the publication of the first part of this article, that Dr. Wernich had already resorted to this precaution for a long time. Compare also his article in *Virchow's Archiv*, Band lxxviii.

<sup>3</sup> Gintrac: Cours théorique et clinique de pathologie interne, etc. Tome viii, Paris, 1869.

non-specialists, it is a question whether they did not consider it superfluous to direct attention to this symptom of purulent otorrhœa, simply because it had come to be regarded as a matter of course.

I would say, finally, that I have as often noticed the odor characteristic of caries, although caries was not really present, as inversely. The bad odor indicates putrid decomposition, which oftentimes follows caries.

### PART III.

#### THERAPEUTICS.

With the proof that schizomycetes colonize in the meatus in purulent perforative otorrhœa, we have now a rational basis for the various plans of antiseptic treatment lately suggested in this affection. We can, moreover, advance one step further, and distinguish :

1. Fresh cases of otitis media which are as yet uncomplicated with the immigration of schizomycetes.

2. Chronic cases, already infected with these organisms, and

adopt a regular treatment for each class.

The treatment which has hitherto prevailed, in so far as concerns the influence of schizomycetes upon the middle ear, has been almost entirely *antiseptic* ; it has simply aimed to destroy the putrefactive condition already present. But for myself I lay great stress in fresh cases on the *aseptic* treatment, *i. e.*, to prevent the immigration of schizophytes, and to stop the putrid decomposition of the secretion as well as the suppuration.

In the second class it is necessary, in addition to antiseptis (which is even nowadays left too much out of account), to follow out the therapeutical indications necessitated by the structure of the affected parts, their physiological peculiarities, and, above all, by their pathological alterations.

#### I.—Treatment of Fresh Cases.

##### *Asepsis.*

The aim of Lister's method is to prevent schizophytes

from invading the surfaces of wounds after injuries, ulcerations, etc. If we succeed in this we obtain asepsis, so that the chances for recovery by first intention, without suppuration, become extraordinarily favorable, as has been proved by innumerable difficult and extensive operations.

If, however, we do not seek for asepsis or attempt it too late, and if schizomycetes which are capable of propagation have already encamped upon the diseased surface, we have to undertake the much more difficult task of making them innocuous and inactive; in a word, we have to strive for antiseptis. But recent experiments have shown that we need much more powerful agents to oppose the activity of schizomycetes, if already present in the putrid secretions, than to prevent their immigration. *Antisepsis, therefore, is much more difficult to obtain than asepsis.*

*If we apply these general considerations to the special relations of inflammation of the middle ear, we find that in the vast majority of cases we do not see the patients until chronic otorrhœa is present, or, at least, until the tympanum is already connected with the meatus by a perforation in the Mt, and suppuration is well under way.<sup>1</sup>*

Instead, therefore, of being able to strive for asepsis, we are in the less favorable position of being obliged to resort to antiseptis. This task, however, with the complicated structure of the tympanum and its adjacent parts, as well as its slight accessibility in case of a small perforation (see below), is oftentimes extremely difficult, while it is infinitely easier, if we can begin at the right time, to prevent the schizomycetes from entering the meatus at all, and thus cause a rapid recovery.

In every fresh case, therefore, I would suggest the following procedure, to which I have resorted for some time with the most brilliant results: When perforation of the Mt appears unavoidable, we should at once perform paracentesis. While it is quite true that almost all aurists agree to this proposition, they only perform paracentesis in order to shorten the duration and intensity of the pain. I follow of

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<sup>1</sup> I leave entirely aside the question of the possible entrance of microphytes or their spores through the Eustachian tubes, and their effect.

course the same idea, yet I aim at the additional point of making a regular linear opening, with much more favorable chances for recovery than in the case of an irregular opening made by a spontaneous perforation. Yet, further, and this is my principal motive, *I operate for the very purpose of disinfecting the tympanum.* Therefore, directly after the paracentesis, which I perform with a carbolized needle, I fill the meatus with finely pulverized boracic acid, which is not only well borne, but fulfils our purpose of warding off the immigration of schizomycetes and causing a rapid recovery.

This method is easily learned and is of so great benefit that I most heartily recommend it to the profession for use in all acute cases, in order to avoid infection of the tympanic cavity by schizomycetes.

## II.—*Treatment of Chronic Cases.*

### *Antisepsis and Additional Therapeutics.*

By "chronic" I mean all those cases in which, although the acute symptoms have ceased or have even been entirely absent, suppuration still continues, and the perforation in the *Mt* is still open. If we follow out the indications suggested by the condition of affairs in these cases, we shall have to act antiseptically; to kill the schizomycetes which are present, or to make them innocuous, or to prevent the immigration of a fresh colony, and in this way to terminate the process of decomposition which keeps alive the suppuration.

These aims are reached in many cases by Bezold's method, which owes its action to the gradual absorption of the mass of boracic acid in the meatus by the constantly secreted fluids, so that every portion of the tympanum is constantly bathed in a weak solution of this acid. If it remained in the ear undissolved it would of course exert no curative action. Furthermore, when we syringe the ear with an aqueous solution of the acid, we can drive the antiseptic to a greater depth than would be possible with a powder, unless we used immense *vis a tergo*. Even with a large perforation, I can hardly comprehend how a powder



can be blown into all the recesses of the complicated system of cavities, to say nothing of the fact that they are usually lined with a swollen mucous membrane, and more or less extensively filled with pus.

The slight solubility of boracic acid (which implies the application of weak solutions only), in connection with other reasons to be later mentioned, induced me to make additions to the method of Bezold, to whom we can hardly be thankful enough for the introduction of such satisfactory treatment into practical otology. But as I was hardly satisfied with its results in all of my chronic cases, I thought over the whole subject and at last invented a *combined method* which has given me much more favorable results in the latter class of cases than the simple method of Bezold.

The train of thought which I followed was this: Our aim in all these cases is to get thorough disinfection; we must kill these schizomycetes, we must put a limit to this process of decomposition. But beyond this, and it is this point which is just now almost *entirely overlooked*, we have a *second task to fulfil; we have to cure the diseased surfaces*.

Now this problem is by no means solved by obtaining simple antiseptis, since the pathological alterations of the parts concerned, although caused by the process of decomposition, do not cease spontaneously with the cessation of the decomposition, but demand especial treatment of their own. Therefore, the treatment which I have adopted in these chronic cases has for its double aim the disinfection by antiseptics of the secretions which cover the diseased surfaces, and, secondly, the cure of these surfaces by suitable astringents.

*Let us now consider the rules for disinfection, preceding them with a few remarks on the antiseptic cleansing which ought to be performed before any application is made to the diseased cavity.*

#### *Cleansing of the Meatus and Tympanum.*

If our treatment of suppuration of the middle ear were to consist simply in the removal of the secretion from the *meatus*, it would be quite sufficient to swab out this cavity

with tampons of cotton, which are highly recommended by many specialists. But it is plain that we cannot cleanse the tympanum or its adjacent cavities in such a manner. I cannot, therefore, give my assent to the view that this method of cleansing a suppurating middle ear is quite satisfactory.

The first step necessary toward repair is the constant removal of the stagnating and decomposing secretion. Without this we can neither disinfect the locality nor act satisfactorily upon the diseased mucous membrane. The only way in which we can obtain this effect is, in my opinion, by *frequent syringing with a large amount of fluid and a forcible stream*. It is quite evident that a cavity with so many fissures and crevices can only be cleansed from all the secretion which it contains, and as much as possible from the microbes within, by a powerful stream and long-continued syringing. Beyond this, I thus endeavor to enfeeble, as far as possible, the vitality of the micrococci which remain. We know that rest and consequent stagnation are the chief causes of putrefaction, while frequent agitation, *e. g.*, with a stream of water, interferes with this process, as is witnessed in the flushing of drains, etc. Moreover, we know how easily stagnant water decomposes, and how rarely this process occurs in running streams.

Again, a superabundance of moisture exerts a noxious influence upon the growth of schizophytes. The addition of a *slight* amount, on the contrary, increases their growth. It is therefore probable that we can in this way interpret the occasionally harmful results of slight and infrequent syringing of the ear.

Nevertheless, if we use a great amount of fluid we run the risk of making the tissues swell too much by *excessive osmotic saturation*. I am sure that the antipathy of many aurists to extensive syringing is based upon a dread of this unfortunate occurrence, which may be avoided by using anti-osmotic fluids, such as a *concentrated* solution of chloride of sodium.

*Common water always contains numerous micro-organisms*, so that in the very act of using it to cleanse a wound, we

might infect it. But inasmuch as boiling for a length of time always destroys the propagative capacity of these structures, especially in a medium so poor in organic substances as water, I always boil for an hour before using, every fluid which I employ for syringing.

*Desiccation* hinders the development of schizomycetes in the same way as excessive moisture. Would not this fact explain those rare cases in which desiccated masses of pus, etc., have remained for a long time in the tympanum and its adjacent cavities without any injurious effect, while the instillation of even a slight amount of water, as is the case with careful syringing, produces the most violent inflammatory symptoms? This phenomenon is usually ascribed to the rapid swelling of the collected masses, but it seems to me that this is due *to a renewed excitation of the decomposition which has hitherto been in a state of suspense*. So long as the schizomycetes and their spores are dry, their further development is hindered. But the addition of water causes a stormy increase in the microphytes as well as a rapid decomposition of the albuminoid corpuscles, in which train of symptoms *we are not to forget that it is the initial products of decomposition which act so noxiously*. My opinion on this point is supported by the fact that the masses removed from the meatus under such circumstances possess a noticeable putrescent odor. If we wish to avoid all possible danger in those cases in which experience teaches us that the above symptoms may appear, it is best to syringe abundantly and repeatedly with water which has been rendered antiseptic by boracic acid, alcohol, etc., by which means the putrid decomposition will be held in check.

In so far as concerns the cleansing of a suppurating ear, it is important not only to show the person entrusted with the syringe how to use it, but also to let him go through with the whole procedure in our presence. It is also important to have a proper syringe. For eighteen years, I have used syringes provided with a groove along the conical nozzle, so that the fluid runs off more easily and too strong pressure is avoided.

*The size of the perforation* is another important point in

the treatment of otorrhœa. It is self-evident that we should not be satisfied with simply treating our cases with antiseptics, or astringents and caustics in connection with cleanliness, but be sure that the remedies really reach the seat of the disease (tympanum and adjoining cavities). This is of course impossible in the case of minute perforations in Shrapnell's membrane (where they are, moreover, often concealed by granulations or polypi) or in the *Mt* itself. I think that these minute openings almost always exist in the anterior portion of the periphery, the thin cicatricial tissue which covers a larger loss of substance in this region being often perforated so minutely that we cannot see the hole, and can only recognize its existence by hearing a faint squeak when we use the air-bag or the patient blows his nose. It is well known that such cases are very hard to cure, and simply, as I think, owing to the opening being so small that we cannot treat the surfaces of the tympanum at all efficiently. It is therefore indispensably necessary for us to enlarge such perforations by a sufficiently extensive incision, in order that the syringing-water as well as the lotions may fairly reach the diseased cavity. If it is impossible to fix the situation of the perforation, *e. g.*, on account of a peculiar conformation of the walls of the meatus, we must make a free incision at some suitable place, and try to keep it open as long as possible. By following out these rules we shall hasten recovery, just as we do by enlarging fistulous openings, by making counter-punctures, etc., in other portions of the body.

At the same time we must force *air* freely through the tubes and tympanum, not only in order to blow out the secretion, but to fulfil still another important indication. Stagnation in the air leads to putrid decomposition just the same as stagnation in water.<sup>1</sup> Frequent renewal and agitation of the air hinder decomposition. The insufflation of chloroform vapor, which is likewise an antiseptic agent, might increase this action in a high degree.

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<sup>1</sup> Compare the conclusions of the Moscow Surgical Society, "*Méthode d'aération : traitement rationnel des plaies*," 1877.

*Treatment of the Diseased Surface.*

If we could only treat every case of acute otitis media before perforation of the *Mt*, or at least directly after it occurred, we should undoubtedly obtain a perfect recovery in a very brief time by the above-mentioned antiseptic treatment. The only exceptional cases would be those dependent upon some severe constitutional affection such as tuberculosis, typhus, diphtheritis, etc. On the other hand, the percentage of disturbances of hearing after the acute exanthemata would be reduced to a minimum. Nevertheless, it cannot be too earnestly insisted upon that, as things now stand, the specialist rarely sees cases of this nature until the favorable moment has long since passed, either because the aural affection was overlooked in the presence of the severe constitutional disease, or because it was left to get well of itself.

In a vast majority of cases, therefore, the diseased surface is already infected with putrid organisms, so that we must at once begin with the antiseptic treatment. But even then we have not done all.

In addition to the decomposition of the pus we generally find extensive alterations in the lining of the tympanic walls as well as of the ossicles and the neighboring cavities. The deeper tissues also are often affected. The mucous membrane is swollen, infiltrated, or hyperplastic; its epithelial layer has been lost; while ulcerations or granulations are frequently noticed upon its surface.

While we may style the antiseptic treatment a defensive and, as it were, a preventive method, the anatomical conditions just described, as well as the functional disturbance, require, if we may so style it, an offensive treatment, a positive and energetic attack.

In order to fulfil this double purpose, I add to the simple boracic acid, which is soluble with difficulty, and to its directly curative action, a substance—alcohol—which increases the antiseptic effect of the acid, and exerts a beneficial astringent action upon the diseased surfaces of the affected regions.

Although I have for years been well assured of the ex-



cellent effects of alcohol in suppurative otitis media, and regarded its energetic action upon the diseased mucous membrane as a modification of the condition of the tissues by desiccation and molecular coagulation of the albuminoid fluids, I now lay great stress upon the beneficial antiseptic action of this remedy.<sup>1</sup> In point of fact, this action has long since been resorted to in the preservation of anatomical preparations, and even of entire bodies, for the purpose of opposing decomposition in fresh tissues and cutting it short in old.

Although a liquid remedy can penetrate into all cavities and fissures, it cannot remain everywhere in permanent contact with the diseased surfaces, which is another point in treatment upon which I lay great stress. This condition, however, can be fulfilled by keeping a reserve of active material in the meatus in the shape of a pulverized remedy whose gradual solution produces a continuous action. *For this reason I resort to a combination of alcohol and boracic acid.*

Whilst boracic acid is soluble in absolute alcohol in only one part in twenty-five, I order an addition of 10 to 20 per cent. more than this vehicle can dissolve. Before using, I shake the mixture well in order to distribute the superfluous powder evenly, and then I warm a part of it (at first diluted with considerable water, then stronger and stronger) in a test-tube and pour it into the ear. In this way the boracic acid is carried along with the fluid, reaches all the surfaces, and by inclining the head toward the healthy side, it sinks by its own weight into the deepest cavities.

I will here call attention to the important point of *completely filling the meatus*, since the action on the schizophytes and the coagulatory effect upon albuminous substances manifests itself all the more forcibly, the greater the amount of active substance which comes into contact with them. Moreover, as a prolonged contact is just as important as the above point, I let the lotion remain in the ear as long as possible.

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<sup>1</sup> Thausing: *Allg. Zeitsch. für Bierbrauerei*, etc., Band vi. Anti-fermentative action of alcohol.



I find this method more suitable and more applicable than my former one of using the above remedies alternately: insufflating the pulverized boracic acid at evening and instilling the alcohol in the morning.

By using both of these methods, especially *the supersaturated alcoholic solution of boracic acid*, I have cured many a case in which boracic acid alone was of no benefit. The significance of the results thus obtained is easy to explain when we consider the inefficiency of merely antiseptic agents against the pathologico-anatomical substratum of this disease and the powerful action of alcohol in this respect.

Even granulations and polypi often disappear under this treatment without any direct operative interference. Alcohol alone also gives us the same result, as both Politzer and myself have noticed for many years.

Satisfied with the results which I have obtained by this method of treatment, I have not as yet experimented with other substances dissolved in alcohol, more especially since boracic acid is the least irritating of all antiseptics, as is proved by the fact that it can even be used on mucous membranes in a condition of acute inflammation.

After successfully using this method, or the simple boracic-acid treatment, I noticed in some cases that, despite the disappearance of every symptom of putrefaction (disagreeable odor, etc.), and an advance toward recovery, *the microscope still revealed occasional clumps of cocci*. I will mention, by the way, that Klebs (*l. c.*, page 107) "rarely failed to find his microsporon septicum in laudable pus." Moreover, schizomycetes which are still capable of propagation are often found under Lister's antiseptic bandage even when thoroughly and successfully applied. I willingly confess that I cannot explain these facts, which seem to oppose the modern theory of the recuperation of wounds, and I can only say that we cannot as yet correctly explain these phenomena. When other authors try to support their views by declaring that such micro-organisms are "incapable of invasion," I cannot but regard it as a most unsatisfactory method of begging the question. Billroth's opinion<sup>1</sup> that

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<sup>1</sup> Billroth, *Allg. Chirurg. Pathol.*, 9 Aufl., page 183, Berlin, 1880.

those micrococci only are inflammatory "which originate in certain inflammatory products, in decomposing pus, urine, etc., and there receive the fermentative principle" is much more precise.

Besides using alcohol and boracic acid in combination, I have employed other antiseptics and astringents, *e. g.*, the *insufflation of a mixture of pulverized boracic acid and alum*. Still, I have not as yet had sufficient experience with this method to be able to define its precise value. Nevertheless, I will here emphasize the following point, which is to be borne in mind in using alum in any combination: it is well known that hyphomycetes (*aspergillus penicilium*, etc.) are frequently observed in solutions of alum and other substances, as I long ago noticed and recognized as a cause of otomycosis.<sup>1</sup> The facility with which these parasites make their appearance in solutions of alum especially, lies, in my opinion, not so much in the chemical nature of the substance in solution, as in the contamination of the finely pulverized and carelessly guarded or manipulated alum with dust, to say nothing of all sorts of spores or germs. I have, however, tried to deaden their effect by applying great heat to the powder before dissolving it, and afterward by boiling the solution.

These contaminations are often of a coarse and macroscopic nature. Thus, I noticed most extraordinary inflammatory symptoms in the *Mt* of one patient after the first insufflation of the mixed powder of alum and boracic acid. On syringing the ear, large clumps were removed, which even by weak powers showed a variety of mineral and vegetable contaminating substances. Among them there was found even a particle, visible to the naked eye, which under the microscope was recognized (by the dots) as pine-wood. It is therefore necessary to examine the ordinary alum powder (and perhaps, also, other powders) for contaminations, for we must be sure of the purity of a remedy if we desire correctly to know its effect.

I am inclined to believe that the furuncles observed by other aurists after instillation of alum solutions did not re-

<sup>1</sup> On fungous ear-disease. Cork Congress, 1879. *Les champignons parasites de l'oreille humaine*. Congrès de l'Assoc. Française, Reims, 1880, and *Gazette Hebdomadaire*, 1880.

sult from the chemical effect of the liquid, but from the micrococci introduced with the powder.

In conclusion I would recommend that the powdered boric acid be preserved in well-closed bottles, in order to prevent contamination from dust.

## NECROSIS AND ELIMINATION OF ALMOST THE WHOLE BONY APPARATUS OF HEARING IN AN ALMOST COMPLETE FORM.—RECOVERY.

BY DR. S. POLLAK, ST. LOUIS, MO.

IT does not often happen, when all the tissues of the auditory apparatus are destroyed by disease, that the affected parts are cast off by nature's own efforts, with complete restoration to health and only a loss of hearing.

It is well known that suppurative inflammation of the middle ear is often destructive in its results, not only to hearing, but sometimes even to life, if neglected or improperly treated. But such is the recuperative power of youth or childhood, that even the cranial cavity may be invaded, the vaso-motor system encroached upon, nerves and blood-vessels lacerated or severed, alimentation and nutrition impaired, mental and physical repose rendered impossible, and nevertheless such patients will sometimes recover without medical aid, and perhaps in spite of it.

The following case, which was brought to my *clinic at the Eye and Ear Infirmary* of the *St. Louis Hospital*, is a typical illustration of the above.

A girl, aged five years, of very healthy parents, and living in a very healthy part of the city, was suffering from profuse fetid otorrhœa from the *left* auditory canal; pus was also flowing from a wide opening in the mastoid process and from an opening on the posterior surface of the auricle, which was bent over into an obtuse angle by a pus-pouch. The whole left side of the face was tumefied and paralyzed. The eyelids remained *unimpaired*, both in form and function.

The disease began *three years ago* with a suppurative adenitis of the submaxillary gland of the *right* side, which was treated with cataplasms. In due time the abscess was lanced, allowing the escape of a large quantity of fetid pus, which continued to flow for several weeks, but had gradually subsided, and at last ceased altogether of its own accord. Soon afterward ear trouble on the *left side* began, and has continued ever since.

The cardinal symptoms were excruciating pain and fever, which did not abate until otorrhœa set in. This was most likely an *otitis media suppurativa*, resulting in a rupture of the membrana tympani. The physician in charge declared: "The flow cannot be stayed until the ossicles are cast off." So nothing was done for nearly a whole year. Another medicus was then consulted, who said: "The ear is full of polypi, but which cannot be removed until the girl has completed her seventh year." Thus the child was doomed to suffering, until brought to this clinic.

She presented a woful appearance, and was in the highest degree prostrated. She was feverish and without appetite; alvine discharges irregular; she was sleepless from pain, and so nervous that a mere look would set her screaming.

She had to be etherized before an accurate examination could be attempted, in which I was kindly assisted by a large class of medical students and some old practitioners of medicine.

I found through the opening in the mastoid process a piece of necrosed bone projecting, which on being tugged at, was perceived to be the outcropping portion of a long and large sequestrum. Seizing it with a pair of forceps, and making gentle traction, it broke off. This was a part of the *mastoid process and cells*, illustrated by figure 1 in double the natural size.



FIG. 1.

Dipping down again, I seized the remaining fragment and lifted it out with all ease; it proved to be the *entire petrous portion of the temporal bone* (figs. 2 and 3;  $\frac{2}{3}$ ), and thus the cranial cavity has



FIG. 2, the anterior



FIG. 3, the posterior

surface of the petrous bone. In the centre of fig. 2 is the promontory and oval window; in fig. 3, at the junction of the right and middle thirds, the meatus audit. int.; at the junction of the middle and left (lateral) thirds are the posterior and superior semicircular canals, chiselled open.

most likely been opened. Digital exploration detected some more spiculæ, which, on being withdrawn, proved to be the *osseous portion of the external auditory meatus* (fig. 4;  $\frac{2}{1}$ ).

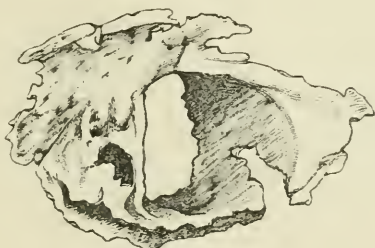


FIG. 4.

Bleeding was very profuse, both from the mastoid opening and the auditory canal. I feared a laceration of the jugular, or a rupture of the petrosal sinus of the dura mater. The hemorrhage, however, was soon arrested. Three long but small polypi were found in the meatus and twisted off. The cavity left after the removal of the sequestra felt smooth and soft, as if lined with vigorous granulations, which undoubtedly had sprung up all around the necrosed bones, and thus enucleated them. The cavity in the mastoid and the meatus were filled with absorbent cotton dipped in iodoform.

Improvement began and has progressed rapidly ever since. A profound sleep of twenty-two hours followed immediately the extraction of the sequestra, a boon denied her for so many years; a desire for food followed. One by one all the physio-



logical functions of returning health set in. She slept, she ate, she became cheerful and playful.

The tumefaction of the left side of the face subsided rapidly, but the paralysis remains, owing to the destruction of the portio dura.

The opening in the mastoid process closed within a week, and also the opening in the auricle, which finally resumed its normal position.

The flow of pus from the auditory canal grew less and less daily, and become odorless. The auditory canal is now funnel-shaped, or conical, terminating in a cul-de-sac.

The tonsils are of normal size. I presume the Eustachian tube will soon be obliterated entirely, there being no further use for it.

It is unaccountable why the motility of the orbicularis palpebrarum should remain unimpaired. She closes the lids when asleep; no trace of a lagophthalmia.

Although she is gaining in health and strength daily, still I enjoined that only moderate physical exercises be allowed. The exposure, or rather the want of due support to the cranial cavity, may forebode danger, which might become serious, or even fatal, upon extraordinary exertion.

We may expect that the dura mater, as well as the periosteum, will become osseogenic, and thus fill up the chasm caused by the removal of the petrous portion of the temporal bone.

TREPHINING OF MASTOID IN A CASE OF OTITIS  
CATARRHALIS CHRONICA, WITH AN INTACT  
MEMBRANA TYMPANI. OPENING OF THE LAT-  
ERAL SINUS. RECOVERY BY FIRST INTENTION.

By H. KNAPP.

ONLY a few cases have been published in which the mastoid was opened when there was no suppuration and the membrana tympani entire. In the case here to be reported I was led to resort to this operation by constant pain which, starting from a tender mastoid, extended over the corresponding side of the head, incapacitating the young sufferer from pursuing her education. The history is as follows.

Miss Maggie B., æt. 16, of New York, has had chronic non-suppurative inflammation of both middle ears for the last seven years. Her mother had been deaf from the same cause. She (the daughter) was subject to colds in her head, and when she presented herself to me for the first time, on October 24, 1881, the mucous membrane of her naso-pharyngeal cavity was uniformly, but only moderately red and swollen. The auditory canals were of normal width, dry, covered with some scales. The *Mtt* were dull-white, not sunken, the light spots scarcely perceptible. The tubes were somewhat narrowed, but open. Her hearing,  $\frac{1}{2}$  R  $\frac{1}{2}$ , L  $\frac{1}{2}$ ;  $\nu$  L  $\frac{12}{60}$ , R  $\frac{5}{60}$ , was but little improved by Politzer's experiment. She did not come to me on account of her hardness of hearing, but on account of a constant pain, which for three months had centred in the left mastoid process, extended over the whole left side of the head, and occasionally run through the face and down the neck. It disturbed her sleep and made the slightest mental

efforts impossible. In spite of all care it had been so persistent and distressing that she had been obliged to leave school, which she did very reluctantly.

I found the skin over the left mastoid process slightly red and swollen, but very tender to the touch. The pain from pressure on the mastoid always radiated over the side of the head. The other mastoid region was normal, and could be pressed and even hammered upon without causing any discomfort.

I advised her for a week to avoid physical and mental exercise as much as possible. She did so, but returned stating that rest had not alleviated the pain in any way. I found her hearing somewhat better, but the condition of the ears, and especially the left mastoid region, unchanged.

Supposing that a chronic inflammatory process was going on in the left mastoid cells, penning up muco-purulent or sanguinolent liquid, I proposed to open the mastoid, to which she and her relatives not only consented, but urged me to do all in my power to relieve this long suffering which rendered her unfit for any thing, and depressed her spirits in an alarming degree.

On November 3, 1881, in the operating-room of the New York Ophthalmic and Aural Institute, and before the students, I performed the operation in the following way. The patient being fully etherized, I made a vertical incision three *cm.* in length, one *cm.* behind the insertion of the left auricle. The periosteum was not thickened, and the surface of the bone was white and smooth. The periosteum was scraped off from the bone with a raspatory the whole length of the wound to the breadth of two *cm* in the middle. As in this whole region both the periosteum and the bone had proved perfectly normal, I at once concluded to chisel the mastoid process open. This was done with a very sharp chisel of good steel, the cutting edge of which was 5 *mm.* long. I have found this kind of chisel the most reliable and efficient in the removal of bony growths, some of which, by their ivory hardness, resist almost all other instruments. By steady and gentle hammering I chiselled a vertical elliptical groove of two *cm* in length, and 1.5 *cm* in breadth into the bone. The surface of the groove was perfectly clean, the pieces of bone coming off like the chips from a piece of hard wood. The edge of the chisel was mostly directed downward, but at times also upward, in order to keep the chiselled surface smooth and like a nicely carved navicular fossa.

The bone in its outer layers, to the depth of about 4 *mm.*, was

white and shining like its surface ; in its inner layers, however, it was markedly hyperæmic, requiring frequent wiping away of the blood. The bone substance was compact in the whole depth of the wound. When the fossa was 6 *mm* deep, the probe discovered soft tissue which, on gentle pressure, let dark blood flow out in an uninterrupted stream. Cessation of the pressure stopped the hemorrhage at once. Further cautious soundings, in order to explore the cavity, always had the same result,—an abundant welling out of dark blood, in which an admixture of muco-pus, though looked for, could not be clearly recognized. As the quantity of blood thus escaped was greater than the cavity of the mastoid could hold, I felt satisfied that the blood was derived from the lateral sinus, into which either the chisel or the probe had made a small opening. The blood flowing only when the soft tissue at the centre of the wound was pressed upon, I feared no after-hemorrhage, cut away any shreds of periosteum that could have been bruised during the operation, wiped the wound carefully with a sponge, and closed it by five interrupted sutures of fine silk passed through skin and periosteum. A thin and short perforated silver tube was placed into the lower corner of the wound, and the whole region covered with a pad of absorbent cotton, held in position by a flannel roller and exerting, by its elasticity, a gentle but constant pressure. The wound, in this way, was treated as an ordinary phlebotomy, and healed also in the same way without suppuration, in fact without any irritation.

The whole operation had neither been laborious nor tedious. The timid patient had inhaled a considerable quantity of ether, and was very noisy and restless for an hour or two afterward. She then fell asleep, and passed a quiet night.

The *next* morning she felt well, had no fever, complained of soreness in the region of the wound, but said that her old headache had left her.

On the *third* day the bandage was removed, the cotton was dry, no oozing even from the silver tube. The anterior lip of the wound was slightly reddened and swollen.

On the *fourth* day there was a drop or two of puriform moisture on the tube. The tube therefore was removed, and as on pressure no secretion whatever was liberated, and the place where the tube had lain showed a clean fleshy surface, as, moreover, the whole region of the wound was scarcely swollen and not tender to the touch, I left the bandage off altogether in the expectation

that the lower open edge of the wound would scab over, which it did in a few hours.

Two days later the sutures were removed.

The patient was kept in bed for a week, then allowed to be up only an hour or two a day. Twelve days after the operation she was discharged from the Institute, with strict injunctions not to leave her room for another week, and stay in bed the greater part of the day. She followed my instructions faithfully. From the day of the operation to this date, December 12th, thirty-nine days later, she has been free from fever. The integument over the wound was only very slightly swollen, and now shows a linear cicatrix. Neither the membrana tympani nor the adjacent parts of the ear canal ever exhibited any symptoms of inflammation, and the patient's acuteness of hearing is now more than doubled. This is, however, not wholly to be ascribed to the operation, for the hearing in the other ear improved also, though not so much. The previous distressing headache has not reappeared. During the last week she felt quite comfortable, and thinks now to be able to return to her school.

*Remarks.*—The morbid process in our patient may be considered as a *chronic mastoiditis interna leading to sclerosis*. This condition is well enough known and described, and I have seen several specimens of such bones freshly removed from the cadaver. The hyperæmia of the sclerosing bone substance is very characteristic, and strikingly contrasting with the ivory-like cortex of the mastoid.

The constant pain located in the mastoid process, and irradiating over the corresponding half of the head, occasionally also over the face and neck, is the principal symptom of mastoiditis interna, and frequently met with in acute catarrhal or purulent inflammation of the middle ear. The opening of the bone in *acute* mastoiditis commonly shows speedy and favorable recoveries, and those who are accustomed to operate under such circumstances can certainly record brilliant cures; they only should not forget that the vast majority of these cases get well without an operation, when rest in bed and rigorous hygienic deportment are enforced. I could support this proposition by many an example from my own practice. Yet when the symptoms are alarming, and when in spite of strict treat-

ment the headache does not abate, I think the opening of the mastoid indicated. The division of the periosteum (Wilde's incision) is of very little value. The beneficial effects noticed in many instances after this little operation, are, I think, chiefly brought about by the rest and rigorous treatment to which the patients then more readily submit. External periostitis, a much rarer disease than internal periostitis of the mastoid, does not show the intense widespread headache, but rather a local pain, and is indeed greatly benefited by division of the periosteum. If the diagnosis be doubtful the integrity of the periosteum and of the outer surface of the bone may, as has of late been very cogently stated by Dr. F. C. Hotz, of Chicago,<sup>1</sup> determine the surgeon to let the division of the periosteum be immediately followed by the trephining of the bone. The above-described case is a good illustration of this proposition.

I do not know whether the mastoid intentionally has ever been opened for sclerosing inflammation. That it can be done with safety and benefit is demonstrated by our case. The indication would chiefly lie in the persistent pain, centering in the mastoid and thence irradiating over the head. The case which comes nearest to ours, so far as I have perused the incident literature, is the xlvii<sup>th</sup> of Schwartze's series, in the *Arch. f. Ohr.*, xiii, p. 249.

The accidental opening of the lateral sinus in some cases was, as in ours, not followed by any consequences; in others it has proved fatal. Whenever it occurs, I would, after careful cleansing, at once hermetically close the wound, and let the patient lie in bed as immovably as after a cataract extraction, for healing without suppuration is in the one instance as essential as in the other. Carbolic acid spray and specifically antiseptic substances are, in my opinion, not only superfluous, but may do harm, in so far as by their chemical action on the tissues they are much more apt to favor than to prevent suppuration. The well-known conditions for obtaining union by first intention are: incised and not contused wounds, perfect cleanliness in all manipula-

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<sup>1</sup> These ARCHIVES, vol. ix, p. 156.



tions, removal from the wound of all foreign bodies including shreds of bruised tissue, sawdust, or small particles of bone and blood in more than minimal quantities; furthermore, perfect and, if possible, hermetical closure of the wound, immobility of the parts concerned, and rest of the body.

In the above case no specifically antiseptic substance or method was resorted to. The recovery could not have been smoother under any kind of treatment. One example, of course, does not prove any thing, but I may here state it as my personal experience, that such recoveries, under like circumstances, are the rule from which there are only few exceptions.

In concluding the remarks on our case I cannot omit to mention that some doubt may be entertained as to whether the lateral sinus was really opened, or whether the blood came from the cavity of the mastoid process, the communication of which with the tympanum having been obliterated by the chronic catarrhal inflammation. "In such a case," says Urbantschitsch,<sup>1</sup> "the air is gradually absorbed and replaced by a bloody-serous fluid." It was on the supposition of the presence of such a closed cavity that the operation was undertaken, and bolder probing or more extensive chiselling might, perhaps, have verified the supposition, yet the hemorrhage at each pressure was so abundant and steady, and the blood so uniformly dark red, that I believed it to come from the lateral sinus. Even if I had felt less convinced of this condition, I would have given the patient the benefit of the doubt, abstained from risky explorations, and treated the wound as a phlebotomy.

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<sup>1</sup> Text-book, p. 445.

**On Epidemic Cerebro-Spinal Meningitis and the Subsequent Combined Disturbances of Hearing and Equilibrium.** By Dr. Moos, Professor of Otology at Heidelberg University. Large 8vo, 68 pages. Heidelberg: Carl Winter, Publisher, 1881.

Reviewed by Dr. OSCAR WOLF, of Frankfort-on-the-Main.

(Translated by James A. Spalding, M.D., Portland, Me.)

Moos has worthily celebrated the twenty-fifth anniversary of his graduation in medicine, by dedicating the monograph now lying before us to his faithful friend and colleague, Dr. H. Knapp, of New York. It would be "carrying coals to Newcastle" were we to mention in these pages the deserved renown which both of these skilful men have gained in the development and extension of scientific otology. We will, therefore, content ourselves with joining heartily in the wish of the author, "that kind fortune may continue to favor the mutual labors of both men."

The book itself, the material for which Dr. Moos has been collecting with his well-known conscientiousness for more than eighteen years, embraces in a critical review the various literary notices upon this subject that have hitherto been published, while by the addition of much that is new and interesting, in so far as concerns the combined disturbances of hearing and equilibrium, it offers a finished picture of our knowledge in this difficult and much-disputed field. Therefore, the little book will be welcome, not only to the specialists, but to all who are interested in the study of the physiology and pathology of the central nervous system.

In so far as concerns the *etiology* and *morbidity* of epidemic cerebro-spinal meningitis, Moos makes use of his sixty-four cases to demonstrate that most of them were seen between 1865 and 1871, and that sporadic cases still occur in those districts of Germany in which an epidemic formerly raged. He thinks that the affection is noticed more frequently in the winter and spring. The

age and sex of the patients are also briefly registered. Moos adopts Ziemssen's division into four forms, but warns us not to diagnose an independent labyrinthine affection, in the so-called abortive form. Finally, "the complications with other diseases, the various symptoms in the cases under observation (especially the initial symptoms), the affections of the organs of special sense, and the sequelæ," are all duly considered.

A review of the "frequency of the subsequent disturbances of hearing" shows that authors differ a great deal in their percentages of permanent disturbances, in comparison with the total number of affections observed. Thus, Moos, in his cases, found 59.3 per cent. deaf-mute, 31.4 per cent. deaf without deaf-mutism, 7.8 per cent. permanently hard of hearing, while only one patient (1.5 per-cent.) escaped without any subsequent affection of hearing. Supplementary remarks are added on the "period at which the hearing becomes affected, the prognosis of restoration of hearing, and on the loss of speech."

In the chapter "on pathological anatomy," the author takes it for granted that we know what alterations take place in the brain and spinal cord in cerebro-spinal meningitis, and pays particular attention to those changes "which may be of interest in determining the functional disturbances of the organ of hearing, or in elucidating the disturbances of equilibrium."

All of these deductions must be studied in the original. We will, however, merely notice that, in explaining why the facial nerve, although lying close to the auditory nerve, is so rarely affected, Moos shows that the facial nerve is chiefly nourished by different blood-vessels, *i. e.*, by the stylomastoid and middle meningeal arteries, while the internal auditory artery, which accompanies the auditory nerve, sends only a very small twig to the facial nerve. He also considers the *labyrinthine affection*, in a majority of his cases, as due to a *neuritis descendens*; *i. e.*, as a slow encroachment of the inflammation from the interior of the cranium into the labyrinth, along the perineurial vessels of the auditory nerve.

We learn from the "analysis of the subsequent disturbances of hearing," that whoever hears the higher tones better after the disease, or hears the lower tones badly or not at all, has greater chances for improvement in his comprehension of spoken words than if the inverse is the case. If absolute deafness persists for more than three months, the prognosis is bad, without any excep-

tion. A more favorable prognosis may be made, if subjective sensations of sound re-appear during convalescence, provided that the hearing had previously been wholly lost. Moos has but little hope of success from treatment in the series of cases now under consideration. In those cases, however, in which hearing has not been absolutely destroyed, the *constant current* offers some hope for improvement.

The most important symptom of all, in a physio-pathological point of view, "the staggering gait subsequent to the disease," is next analyzed. The author regards the semicircular canals and their ampullæ as the "probable seat of the disturbances of equilibrium subsequent to cerebro-spinal meningitis," and bases this opinion upon a recapitulation of the results of experimental physiology and pathological experience. We cannot, of course, at this place, repeat the contradictory views of Moos and Baginsky, and will merely remark that we agree with Moos, as we have already done in our review of Baginsky's paper.<sup>1</sup>

The result of the monograph is summed up in *eight conclusions*, with which we can all the more readily agree, since they express only fundamental facts, and reserve for further investigation the final solution of the question of the function of the nervous apparatus in the crista of the ampullæ and the sacculi.

Finally, we must call attention to the criticism on CHARCOT'S treatment of auditory vertigo. Moos acknowledges that quinine is advantageous in some cases, but he believes that it acts by antagonizing inflammation, and not, as Charcot thinks, by destroying the remnant of hearing as well as the functional activity of the auditory nerve. The histories of sixty-four cases, with remarks and notes, make a valuable conclusion to this latest work which Moos has given to the profession.

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<sup>1</sup>These ARCHIVES, vol. x, No. 3, page 281. We must, however, add that our opinion was entirely independent of that which Moos here lays down, for both papers were in the printer's hands at the same time.

## ABSTRACT OF AMERICAN OTOLOGICAL LITERATURE DURING THE SECOND AND THIRD QUARTERS OF THE YEAR 1881.

BY DR. SWAN M. BURNETT, OF WASHINGTON, D. C.

Great reproductive power of the membrana tympani. A new method whereby the Eustachian tubes may be permanently opened, dilated, and treated, etc. By A. W. ADAMS. *Rocky Mountain Med. Rev.*, June-July, 1881.

A. relates three cases of long-standing and profound deafness due to dry catarrh, which were relieved by taking out a section of the *Mt* and treating the mucus membrane locally, through the opening thus made. In all of these cases he found the drum-cavity filled to a greater or less extent with dried mucus, which required considerable time to soften and remove. He reports that the *Mt* healed kindly after treatment was at an end.

Desquamative inflammation of the ear. By J. ORNE GREEN. *Boston M. & S. Journal*, July 21.

G. relates five typical cases of this affection in detail, and quotes largely from the published literature on the subject. He thinks that large collections of epidermis in the ear are of three kinds. 1. Desquamative inflammation of the meatus, membrana tympani, or tympanic mucus membrane. 2. Pearl tumor of the tympanic mucus membrane. 3. Endothelial tumor of the lymph-spaces in the drum membrane.

Fatal otitis. By G. C. HARLAN. *Phila. Med. Times*, Aug. 27.

Five cases are related in which death resulted from an extension of inflammation from the middle ear to the brain.

Two cases of perforation of the membrana tympani from *ascaris lumbricoïdes*, with remarks upon the curious habits of this human parasite. By C. S. TURNBULL. *M. & S. Rep.*, July 9, 1881.

Deafness as the result of the poison of syphilis. By LAURENCE TURNBULL. *Med. & Surg. Rep.*, Dec. 11, 1880, and Aug. 6, 1881.

Three cases are related: two of *heredito-syphilitic* disease; *no relief to hearing from treatment*, but much improved by the use of auricles; and one of keratitis parenchymatosa, *otitis media catarrh*, and *otitis interna heredito-syphilitica*; recovery. He is of the opinion that syphilitic diseases of the ear are less common in the United States than in Great Britain and Europe.

Rupture of drum-head from a box on the ear. By A. S. GORE. *Peoria Med. Monthly*, August.

The left *Mt* showed a clean, straight and almost vertical incision 3 mm. in length, the centre being behind the insertion of the manubrium. There was no hemorrhage. The wound had healed at the end of a week, and hearing power was completely restored.

Primary abscess of the mastoid process by E. GRÜNING. *Med. Record*, June 4th.

There was no history of catarrhal inflammation of the middle ear, but there were hardness of hearing, tinnitus, and stiffness of the neck, pain on pressure over the mastoid, but no swelling. Leeches and a Wilde's incision failing to give relief a perforation of the mastoid process was made, and about eight drops of pus let out. The patient was relieved of all the symptoms but a tinnitus which is still present.

Substitute membrane in the aural canal. By FRANCIS VALK. *Med. Record*, Oct. 22.

Two cases are related in which, after total destruction of the drum-membranes by suppurative processes, new membranes were formed, occupying very nearly the seat of the normal *Mt*.

Abscess of the mastoid cells from the use of the nasal douche. By A. M. ROSEBURGH. *Canada Lancet*, vol. vi, p. 206.

Death from the use of the nasal douche. By R. W. TAYLOR. *Med. Herald*, October.

The patient was a man 55 years of age, afflicted with nasopharyngeal catarrh. After the use of a nasal douche he was affected with an acute inflammation of the middle ear, which in the course of a few days was followed by severe chill and alarming head symptoms, offering all the characteristics of cerebral meningitis. He died 53 hours after the initial chill. No autopsy.

Dental sound-transmission. The Japanese otacoustic fan. By SAMUEL SEXTON. *Med. Record*, Sept. 10th.



S. has contrived a sound transmitter which can be attached to Japanese or other fans, and removed and carried in the pocket when not in use. It consists of a German-silver plate folded together but leaving space enough to receive the edge of the fan between its free edges. The mouth-piece of the transmitter is slightly turned up, thus affording a better adaptation to the teeth than the edge of the fan. While not as good as the ear-trumpet, S. thinks the otacoustic fan possesses the advantage of inconspicuousness.

Nasal stenosis. J. O. ROE. *Trans. Med. Soc. of State of N. Y.*, 1881.

R. devotes a section of his paper to the influence of nasal obstructions on the apparatus of hearing. The effects produced by this obstruction may be merely functional, but are likely to lead, sooner or later, to structural changes, both in the drum-cavity and the Eustachian tube. The methods of dealing with these nasal obstructions are considered in full.

## REPORT ON THE PROGRESS OF OTOLOGY FOR THE FIRST HALF OF THE YEAR 1881.

Translated by R. C. BRANDEIS, M.D., of New York.

### III.—PATHOLOGY AND THERAPEUTICS OF THE ORGAN OF HEARING.

BY A. HARTMANN, OF BERLIN.

#### GENERAL.

1. HESSLER. Statistical report of the cases examined and treated in the policlinic at Halle a. S., from Oct. 15, 1879 to Oct. 15, 1880. *Arch. f. Ohrenheilk.*, vol. xvii, p. 40.

2. A. MARIAN, Aussig. Report of the cases of diseases of the ear, treated from Oct., 1878 to Oct., 1880. *Ibidem*, p. 48.

3. K. BÜRKNER, Göttingen. Report of the cases treated in my policlinic for the diseases of the ear in 1880. *Ibid.*, p. 187.

4. HEDINGER, Stuttgart. Report of the Institute for Diseases of the Ear in Stuttgart, from 1877 to 1879, etc. Stuttgart, 1880.

5. Eleventh annual report of the N. Y. Ophthalmic and Aural Institute, New York, 1881.

6. First annual report of the Newark Ophthalmic and Aural Hospital. Newark, 1880.

7. J. HEBERMANN. Comprehensive report of the otological clinic of Prof. Zaufal for the year 1879. *Archiv f. Ohrenheilk.*, vol. xvii, p. 24.

8. ROBERT SINCLAIR, Dundee. Epitome of a paper on the nature and relations of diseases of the ear. *Lancet*, Feb. 5 and 12, 1881.

9. K. BÜRKNER, Göttingen. Diseases of the ear in railway employés. *Archiv f. Ohrenheilk.*, vol. xvii, p. 8.

10. J. GOTTSTEIN, Breslau. Contributions on the diseases of the ear occurring during the course of the acute exanthemata. *Archiv f. Ohrenheilk.*, vol. xvii, p. 16.
11. ORNE GREEN. Clinical observations. *Amer. Journ. of Otol.*, vol. iii, p. 135.
12. J. GRUBER, Vienna. On the open mouth of the deaf. *Monats. f. Ohrenheilk.*, No. 5, 1881.
13. J. GRUBER, Vienna. On the condensation and rarefaction of air in the external auditory meatus as a therapeutic agent in the treatment of diseases of the ear. *Wien. Med. Zeitschr.*, Nos. 1 and 2, 1881.
14. E. ZAUFAL. Disinfecting capsules in connection with the ordinary air douche. *Archiv f. Ohrenheilk.*, vol. xvii, p. 1.
15. CRESSWELL BABER, Brighton. Note on the tuning-fork in the diagnosis of diseases of the ear. *Lancet*, April, 1881.
16. A. POLITZER, Vienna. A small instrument for the deaf. *Wien. Med. Wochenschr.*, No. 18, 1881.
17. J. GRÜNFELD, Vienna. A demonstrating mirror attached to the aural speculum. *Mon. f. Ohrenheilk.*, No. 4, 1881.
18. O. D. POMEROY. A modification of the aural and laryngeal reflector. *Amer. Journ. of Otol.*, vol. iii, p. 35.
19. E. TREIBEL, Berlin. The second international congress of teachers of the deaf-mute, in Milan. Published by W. Issleib, 1881.

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7. In HABERMANN's report of Zaufal's clinic the house and dispensary patients are tabulated separately. The tabulation is so complicated that we were unable to incorporate the report in the following table. 971 patients were examined.

8. SINCLAIR endeavors to prove that general therapeutic laws should be applied to the treatment of diseases of the ear; and treats especially of diseases of the middle ear, the removal of their causes, rest and quiet, derivation per alimentary canal, local depletion, and where there is a collection of mucus, paracentesis of the drum-membrane.

9. BÜRKNER has published the result of his examination of 24 railway employés who came to him for treatment. In the locomotive engineers, as well as in the brakemen, bone conduction was impaired, and, as a rule, although hearing of the voice was but slightly dulled, high tones were perceived but rarely, if at all.

Bürkner is of the opinion that these phenomena are due, in part at least, to changes in the labyrinth. He accepts the conclusions arrived at by Moos in great part, and would favor an examination of the switch-tenders and porters as well as of the engineers and firemen.

1-6. The statistical reports are compiled in the following table :

	HESSLER.	MARIAN.	BÜRKNER.	HEDINGER.	KNAPP.	KIPP.
DISEASES OF THE EXTERNAL EAR.						
Perichondritis . . . . .	—	—	1	2	4	2
Eczema . . . . .	11	9	12	25	23	43
Malformations . . . . .	—	—	—	7	—	—
Otit. externa circumsr. (furuncles) . . . . .	25	15	13	91	19	39
“ “ diffusa . . . . .	9	14	17	99	28	23
Impacted cerumen . . . . .	74	87	68	239	112	90
Otomycosis . . . . .	1	2	—	10	1	2
Foreign bodies . . . . .	9	6	2	36	5	5
Exostoses . . . . .	—	—	—	19	—	—
Myringitis . . . . .	1	10	9	29	—	1
Ruptures of membr. tympani . . . . .	2	1	3	26	1	2
Other diseases of external ear . . . . .	1	—	2	14	33	14
DISEASES OF THE MIDDLE EAR.						
Acute (includ. subacute) catarrh . . . . .	109	56	20	286	49	84
Chronic catarrh (sclerosis) . . . . .	99	159	99	1072	431	194
Acute, purulent catarrh (including subacute inflammations of the middle ear) . . . . .	68	33	24	152	12	51
Chronic purulent { without complications . . . . .	41	62	55	370	236	203
{ with polypi . . . . .	24	22	13	216	18	20
{ with caries or necrosis, facial paralysis } . . . . .	12	4	8	12	—	14
Residua of purulent otitis media . . . . .	51	46	16	40	17	23
Catarrh of the Eust. tubes . . . . .	5	5	17	—	—	—
Otalgia . . . . .	14	8	3	16	—	4
OTHER DISEASES OF THE MIDDLE EAR.						
<i>Diseases of the nervous apparatus.</i>						
Ménière's disease . . . . .	1	2	22	{ 3	—	—
Deafness after infectious diseases . . . . .	1	4		{ —	2	2
“ “ meningitis . . . . .	9	3		{ —	4	1
Deaf-mutism . . . . .	1	2	11	20	10	7
NASAL AND PHARYNGEAL DISEASES . . . . .	13	—	—	—	43	—
Other diseases of the nervous apparatus . . . . .	13	40	—	128	5	2
No diagnosis . . . . .	10	—	11	—	—	—

Histories of cases are appended to Hessler's, Marian's, and Bürkner's reports, for which we must refer the reader to the originals. Hedinger appends contributions on the progress of otology in the last few years.

10. GOTTSTEIN emphasizes the importance of attending to the aural affections arising in the course of the acute infectious diseases in their incipency. In one of his patients, suffering from measles, microscopic examination detected a desquamative inflammation of the membrana tympani with perforative, purulent otitis media. In two other cases which he examined during their acute stages, diphtheritic otitis was superadded to measles and scarlatina. Gottstein thinks that Burkhardt-Merian goes too far if he believes that the Eustachian tube is the only way in which a diphtheritic otitis may develop in the course of an angina diphtheritica; it may also be the symptomatic evidence of a general infection. According to Gottstein's experience the aural troubles in scarlatina often only arise after the inflammatory condition of the throat has subsided and he, therefore, arrives at the conclusion that in infectious diseases the "specific causes" of disease are peculiarly disposed to involve the ear.

11. In the case of a young lady, hemorrhages of the right ear were noticed at every menstrual period; these were often quite severe and were attended with headaches. On examination ORNE GREEN found a small tumor, covered with a thin cuticle, in the meatus. The tumor, thought to be the cause of the hemorrhage, was excised and found to be an atheroma; after its removal the bleeding ceased. In another case in which Orne Green observed hemorrhages from the ear during menstruation, there was destruction of the membrane. A third case is reported in which a cyst was found in the meatus, which was only covered by a thin cuticle, occupying two thirds of the passage from the orifice almost to the membrane. Two cases of otorrhœa in phthisical patients, which were cured are also reported.

12. GRUBER discusses the views advanced in the debate following Löwenberg's address, "Deaf persons' gaping," delivered at Milan, and summarizes his views as follows: 1. There can be no doubt that certain ear patients, who are troubled with respiratory noises, owing to obstruction of the nasal passages, are enabled to hear better when their mouths are open. But the idea, that these noises are the sole cause of patients keeping their mouths open when listening, cannot be entertained. 2. The improvement of hearing observed when the mouth is open can be explained by the alteration of the configuration of the external ear canal and the deeper structures of the conductive apparatus, caused by the depression of the lower jaw. 3. In some of these patients it

is the resonance produced by the shape of the mouth, which either alone, or in conjunction with other changes in the conductive apparatus due to the depression of the lower jaw, improves hearing. 4. The facility of respiration, which is found by opening the mouth, may, in some cases, conduce to the increase of hearing power.

13. GRUBER concurs with Weil in attributing to reflex action the removal of tinnitus by inflation of the external meatus; the more so, as he has found, that this can also be effected by the application of cold to the walls of the meatus. He adds that the changes in atmospheric pressure in the external meatus cause alteration in the circulation and the tension of the conductive apparatus and the labyrinth. (The observation, that positive pressure in the ear canal may cause bulging and negative pressure depression of the drum-head, may be due to an ocular illusion caused by monocular vision.—Rev.) As the inflation of the middle ear and the rarefaction of air in the meatus have different effects, it is necessary, in the proper cases, also to investigate the effects of positive or negative pressure in the canal. As a rule, negative pressure acts more beneficially than positive, but both, combined, may do well.

14. The possibility that the air driven by the douche into the middle ear may carry numerous particles of dust and thereby cause irritation in the middle ear and prolong the duration of inflammatory processes, caused ZAUFGAL to attach a disinfecting apparatus to the air-bag. This consists of a spherical capsule, divided into two parts, between which the disinfecting substance is enclosed in a lattice-work of wire. Tubing can be attached to the two ends of the capsule. If it is desirable to attach this to the hand-bag it can be done, and by adding a stop-valve it can be attached to the catheter. The capsule is filled either with Lister's gauze or Bruns' cotton. The gauze is intended to intercept loose fibres of cotton. Chloroform, ether, turpentine, etc., can also be used by means of the bulb.

15. CRESSWELL BABER reports that when a tuning-fork, placed on the median line of the skull, is heard loudly in the obstructed ear, perception will be less and less the more the finger is pressed into the ear. This may be due: 1, to the depression of the chain of bones and the slight increase of the intralabyrinthine pressure; 2, to the impediment of the vibrations of the ossicula in consequence of the altered tension. This is the explanation of



the fact that in some diseases of the middle ear the tuning-fork is heard less distinctly in the diseased ear than in the healthy one.

16. POLITZER observed that the reflection of sound from the concha into the meatus is assisted by the tragus, lying opposite, and the intensity of the sound is considerably increased, when the surface of the tragus is increased, by attaching a small firm plate behind it. To effect this, Politzer devised a little instrument in the shape of a horn, curved at right angles, the smaller end of which is inserted into the meatus, while the larger end rests upon the auricle. It is made of vulcanized rubber. If the sound-waves are directed toward the face, the instrument will increase their intensity. In many cases the improvement of hearing amounts to a hundred per cent. and over.

17. In order to make the otoscopic image visible to a second observer, GRÜNFELD suggests the use of a round or oval plane mirror of  $\frac{1}{2}$ -2 cm. diameter, which is attached to a fork by means of a hinge joint. This fork can be fastened to any aural speculum and may be just as readily detached. The angle between the mirror and the axis of the speculum is generally somewhat more than  $45^{\circ}$ . The first observer looks from the mirror directly on to the drum-head, which is illuminated by the reflector, whereas the second can see the reflected image in the mirror.

18. In POMEROY'S reflector the ball of the joint is attached to a perpendicular rod fastened to the back of the mirror, and then bent at a right angle. The ball is attached to the forehead band by two clamps, which are tightened by means of a screw. By adjusting their relative dimensions free motion is secured. (The up-and-down movement is deficient. This can be secured by means of a double ball-and-socket joint, such as is depicted in the Reviewer's "Diseases of the Ear.")

19. In his report on the Second International Congress of Deaf-Mute Teachers, which was almost altogether attended by Frenchmen and Italians, TREIBEL speaks in highest praise of the discipline of the scholars of the schools for deaf-mutes in Milan. He also reports the proceedings of the Congress, at which, as is well known, articulate language gained a victory over sign-language, as is proven by the following resolutions, which were passed: "Being convinced of the superior merits of articulate language over sign-language, because, 1, the former enables the deaf-mutes to have

intercourse with the outer world, and, 2, enables them to appreciate the true spirit of language, this Congress declares that the use of articulate language is to be preferred in the instruction and education of deaf-mutes." The simultaneous use of the two methods was not advised.

EXTERNAL EAR.

20. HUTCHINSON. Noma of the ear. *Med. Times and Gazette*, Jan. 2, 1881.

21. WEIL, Stuttgart. Circumscribed desquamative inflammation of the external meatus. *Monatsschr. f. Ohrenheilk.*, No. 3, 1881.

22. SAMUEL THEOBALD, Baltimore. Four cases of otomycosis aspergillina successfully treated by means of the oxide of zinc and boracic acid. *Amer. Journ. of Otol.*, vol. iii, page 119.

23. CATRIN, Condé. The removal of foreign bodies from the external canal. *Gaz. Hebdom.*, No. 2, 1881.

24. BARR. Pea in the ear, etc. *Glasgow Med. Fourn.*, vol. xv, No. 5.

25. FRANCIS BROWN, Boston. Impacted foreign bodies, etc. *Amer. Fourn. of Otol.*, vol. iii, page 29.

26. JOY, New York. Two difficult cases of foreign bodies in the ear. *Ibid.*, page 144.

27. FIELD, London. Ivory exostosis in both ears successfully removed by operation. *Lancet*, Jan. 8 and 15, 1881.

28. J. GRUBER, Vienna. Contribution to the knowledge of the new formation of cartilage and bone in the ear. *Wien. Med. Presse*, Nos. 7, 8, and 9, 1881.

29. R. TORRANCE. Rupture of the membrana tympani, with diffuse myringitis, owing to a blow with a snowball. *Brit. Med. Fourn.*, Feb. 5, 1881.

30. E. GAMPIETRO, Naples. A new artificial drum-membrane and its application in practice. *Monatsschr. f. Ohrenh.*, No. 1, 1881.

31. G. CZARDA, Prague. On antiseptics in aural surgery. *Wien. Med. Presse*, Nos. 20 and 21, 1881.

32. MCKEOWN. A new method of treating flaccidity of the drum-head. *Dublin Fourn. of Med. Science*, Jan., 1881.

33. J. GRUBER, Vienna. Incision of the posterior fold of the drum-head. *Wiener Allgem. Med. Zeitschr.*, Nos. 1 and 2, 1881.

20. An acute inflammation occurred in a poorly nourished child, aged 4 years, having chronic otorrhœa, which became phagedænic. In the auricle a perforation was found having a diameter of several *mm.* The edges as well as the surrounding tissues were covered by a dirty brownish deposit. This being removed, under anæsthesia, and the parts well cauterized with acid nitrate of mercury, recovery soon took place. The upper and lower portions of the auricle were united by means of a narrow strip of the helix.

21. WEIL reports a case of desquamative inflammation of the external meatus. It took three weeks before the accumulated mass was removed. The inner end of the canal was dilated.

22. THEOBALD does not think that the use of alcohol for the removal of aspergillus is sufficiently sure, and has had good results from the use of a mixture of oxide of zinc and boracic acid.

23. CATRIN reviews the different methods of removing foreign bodies from the ear, and favors forcible injections. Eight cases are reported in detail in which foreign bodies were removed by means of the syringe.

24. A pea lay two years in the meatus without causing any inflammation. Removed by means of syringe and spatula.

25. BROWN speaks of vegetable foreign bodies which germinate when in the ear. They should not be allowed to remain, but should be removed without delay. The longer they remain, the more difficult will be their removal. Brown's deductions are principally based on those made by others.

26. In two cases JOY was only able to remove foreign bodies by narcotizing the patients and applying a polypus forceps recommended by Sexton.

27. FIELD adds another to his case of ivory exostosis removed by means of the dental drill, which was reported two years ago. This was in a man aged 31, in whom the exostoses, as in the former case, were found on both sides, occluding the canals and rising on both sides from the posterior wall. The operation, for which Field deems three assistants necessary, was first done on the right side, and it took 50 minutes before the drill was able to perforate the tumor. The orifice was dilated two weeks later. The operation on the left side took 55 minutes, and two after-operations were necessary. The walls of the meatus were protected by means of a narrow spatula. At first a fine, and later a

coarse drill was used. It is often necessary to operate in the dark, as the whole canal is filled with blood. It is not necessary to incise the skin before applying the drill. The operation is tedious and difficult, and many complications may arise in spite of every precaution. In the last operation the drill slipped, and, perforating the drum-head, entered the Fallopian canal, causing facial paralysis. This soon disappeared and hearing was restored on both sides.

28. GRUBER agrees with Delstanche and Hedinger that the so-called exostoses are ostoid formations which owe their origin to a hyperplasia caused by a pre-existing inflammation. To these—the rarest form of neoplasm—those produced by newly-formed cartilage may be added. A case is reported in which a hard tumor was found situated about  $\frac{1}{2}$  cm. from the external orifice and completely filling the canal. This was readily removed by means of the chisel—the base was broken off with a forceps. On microscopic examination it was found that the growth was an enchondroma.

29. A rupture of the membrana tympani was caused by the throwing of a snowball; it was parallel to the handle of the malleus and behind it. A few days after the injury a sensation of cold on the same side of the tongue, and an impairment of the sense of taste were noticed. This TORRANCE attributed to an injury of the chorda tympani.

30. In an introduction to the description of a new artificial drum-head, GAMPIETRO gives a description of those used heretofore. He has a particularly poor opinion of Yearsley's cotton pellets and of Miot's artificial drum-head. He thinks (very improperly, Rev.) that the former conduces to the development of new inflammations, and instead of improving audition is apt to make it worse. Gampietro's new instrument consists of a rubber disk, on the lower third of which a perpendicular projection is attached. A gold wire is wound spirally around this, the two ends of which go asunder. These two spring-like ends are pressed together with a forceps and the membrane is introduced into the meatus. It is maintained in its position by the gold wire.

31. In view of the favorable results obtained by the application of antiseptics to otorrhœa, CZARDA thinks that in the introduction of artificial membranes antisepsis must also be of service. He therefore uses Lister's silk protective, which, as he thinks,

possesses antiseptic properties. The silk tympanum can be made more firm by adding small pieces of mackintosh or vegetable parchment. The membrane is introduced by means of a canula or wire.

32. MCKEOWN reports 13 cases of relaxation of the drum-head, which were benefited by the application of collodion. He lauds the advantages of this method, by means of which, in the majority of cases, an immediate improvement of hearing and a diminution of all unpleasant symptoms, such as noises, etc., are achieved. The variations in the acuity of hearing are lessened. Collodion can also effect a permanent increase of the tension of the membrane.

33. In those cases in which the layers of the folds of the drum head, passing in curved lines over the posterior quadrant, adhere to one another, or where foreign bodies are deposited between them, GRUBER does not consider paracentesis in a vertical direction, as is generally done, satisfactory. He performs the operation along the transverse axis of the fold. No results are given.

#### MIDDLE EAR.

34. CHAS. BURNETT, Philadelphia. Perforations of the membrana flaccida, etc. *Amer. Journ. of Otol.*, vol. iii, p. 12.

35. EDWARD ELY, New York. Transplantation of skin in chronic purulent otitis media. These ARCHIVES, vol. ix, p. 343.

36. P. MCBRIDE. Observations of ear disease. *Edin. Med. Journ.*, April, 1881.

37. ENG. MORPURGO, Trieste. On the use of alcohol in the treatment of granulations and polypi of the middle ear. *Lo Sperimentale*, February 2, 1881.

38. ARIZA, Madrid. Aural polypi. Clinical lecture, 1881.

39. F. TRAUTMANN. Fibrous polypi of the mastoid process, which extended through the external auditory meatus. *Arch. f. Ohrenheilk.*, vol. xvii, p. 177.

40. VOLTOLINI, Breslau. Aural polypi and their treatment. *Monatsschr. f. Ohrenheilk.*, No. 2, 1881.

41. H. SCHWARTZE, Halle. Second series of fifty cases of surgical perforation of the mastoid process (continued). *Arch. f. Ohrenheilk.*, vol. xvii, p. 92.

42. SNELL, Sheffield. A case in which the mastoid process was opened, etc. *Lancet*, March 12, 1881.

43. A. BING, Vienna. The diseases of the mastoid process ; their relations to the ear. *Thesis. Wien. Med. Blätter*, Nos. 14, 15, and 16, 1881.
44. BARR. Mastoid periostitis, etc. *Glasgow Med. Journ.*, vol. xv, No. 5.
45. WEIL, Stuttgart. Otorrhœa and its treatment. *Memorabilien*, part ii, 1881.
46. WEIL, Stuttgart. Contribution to the ætiology of retro-pharyngeal abscesses. *Monatsschr. f. Ohrenheilk.*, No. 3, 1881.
47. JAMES POLLAK. Gumma of the mastoid process and temporal region complicated with otitis media purulenta. Cure. *Allgem. Wien. Med. Zeitschr.*, No. 20, 1881.
48. CHAS. TODD, St. Louis. Distressing noise in the ear, probably due to spasm of the tensor palati. *Amer. Journ. of Otol.*, vol. iii, p. 140.
49. RUMBOLD, St. Louis. The Eustachian tube. *St. Louis Med. and Surg. Journ.*, 1881.

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34. BURNETT divides perforation of the membrana flaccida into three classes : First, those in the centre of the membrane, where the neck of the malleus is exposed ; these are generally complicated with diseases of the external meatus, are quite amenable to treatment, and the discharge is not very profuse. Secondly, anterior perforations which lead directly into the anterior upper part of the tympanum, near the tympanic orifice of the Eustachian tube. These are met with in affections of the nose and the Eustachian tube ; the secretion is profuse. They are the most amenable to treatment, and the deafness is generally relieved. Thirdly, posterior perforations, attended with profuse secretion ; here we frequently have symptoms implicating the mastoid process, and find that this form is very intractable and generally attended with intense progressive deafness. Burnett has seen ten cases of perforation of the membrana flaccida, two anterior, three posterior, three central, two involving the entire membrane. The tympanic syringe is of the greatest service in the treatment of these cases.

36. Although, a year ago, Politzer announced his discovery of the fact that alcohol is of great service in the treatment of aural polypi, McBRIDE states that he had had considerable experience of the beneficial effects of this agent without knowing anything of Politzer's announcement. He advises the instillation of



alcohol two to three times daily—at first using dilute, afterwards pure. He also refers to the aberration of taste in aural affections, and reports a case in which a patient who, while having an aural polypus removed by means of a snare, had a sensation as if a wire were drawn around the tongue. There was no taste on that side; on the other, where there were also polypi, it was impaired. He also reports a case of malformation of the ear, which is illustrated by two wood-cuts.

37. MORPURGO reports his excellent results by using alcohol for the cure of three cases of aural polypi. He states that this remedy often requires some time before achieving the desired results—in one of his cases as long as three months. The use of alcohol is indicated when a specialist cannot be consulted, when there is no danger of any fatal complications arising, and when the patient refuses to submit to an operation.

38. ARIZA treats of aural polypi and speaks *in extenso* of their ætiology, nature, and histology. In cases in which the snare fails to eradicate them, Ariza recommends the use of one of Pomeroy's forceps.

39. In one of TRAUTMANN'S patients three polypi were found in the external meatus. They arose from above and behind. On the upper-posterior wall of the meatus a circular opening was discovered, which led into a cavity about the size of a hazel-nut, containing a fourth polypus and friable masses, which, on examination, proved to be the remains of fibrous polypi which originated in the mastoid cells.

40. VOLTOLINI remarks that if on probing polypi or polypoid excrescences great pain is felt, the prognosis is bad, and we may be sure that some serious trouble, such as carious bone, is at bottom. Two illustrative cases are reported. In operating Voltolini uses the galvano-caustic snare, and tears the growth away without heating the wire; or if there be resistance, heats it to the requisite degree. He also uses the galvano-cautery for the after-treatment, by means of a very fine cautery. This operation is comparatively painless.

41. SCHWARTZE reports 13 new cases of operations on the mastoid process. In 7 cases, only a dilatation of fistulous tracts was required. One of these cases (No. 70) terminated fatally, owing to diffuse meningitis, due to necrosis of the labyrinth. In case No. 59 there was a syphilitic periostitis as well as profuse otorrhœa. The bone was chiselled away to a depth of 2 cm. without find-

ing any pus. In spite of this, immediate subsidence of discharge and ultimate cure. Schwartz remarks the painless course of the disease. In Case 63, after the trepanation, there was a sudden escape of a large quantity of fluid, ichorous pus. Subdural abscess (?) on the carious pyramid. Death ensued eleven days after the operation, owing to meningitis.

42. SNELL reports the case of a patient who, besides having an otorrhœa, suffered great pain, which made sleep impossible. On examination he found swelling of the mastoid and neighborhood. While operating, pus was found under the periosteum. He enlarged an existing perforation in the bone, which was followed by a profuse evacuation of pus.

43. BING gives us a résumé of the diseases of the mastoid process based on the writings of Politzer, Gruber, v. Tröltsch, Schwartz, etc.

44. BARR reports a case of acute periostitis of the mastoid which was cured by Wilde's incision.

45. To illustrate the dangers following purulent discharges of the tympanum, WEIL reports two cases on which he made *post-mortem* examinations. In the first an incision was made over the mastoid process, which was followed by a profuse evacuation of ichorous pus; then trepanation of the bone. Death ensued in consequence of the rupture of a cerebellar abscess a few days after.

In the second case death was due to meningitis. He also recommends the use of boracic acid in otitis media.

46. WEIL incised a retro-pharyngeal abscess, which arose during the existence of an otorrhœa, three times. Death ensued owing to an œdema of the glottis. Weil regards the otitis media purulenta as the primary affection, which was followed by purulent destruction of the pharyngeal glands by absorption into the lymphatics. He quotes Korrman, who also says that these abscesses are often caused by otitis med.

47. POLLAK describes a case in which, besides an otitis media and consecutive otitis externa diffusa, a periostitis of the mastoid set in, owing to a partial breaking down and evacuation of pus of gumous tumors.

48. One of TODD's patients had long suffered from a feeling of pressure and weight in the head and an intense rustling noise in the ear. This latter was distinguishable more than six inches from the ear, and much better by means of a stethoscope placed

upon the mastoid, also near the nostrils and the open mouth. It could be produced at will by contracting the muscles of the neck. When the noise is heard, synchronous contraction of the tensor palati takes place. Paracentesis of the drum-head failed to afford relief; faradization of the tubal muscles was only of temporary benefit.

49. RUMBOLD, after having examined patients with abnormally patent Eustachian tubes, arrives at the following conclusions :

1. During deglutition there is no free entrance of air into the middle ear.

2. The walls of the tubes are always in slight contact.

3. Air constantly passes into the tympanum.

4. In the healthy ear the air contained in the drum cavity is of lesser density than the surrounding atmosphere.

5. One of the functions of the tube consists in maintaining this difference of density.

6. Rarefaction of air in the tympanum is the cause of concavity of the drum-head.

7. A certain degree of uniform pressure upon the intralabyrinthine fluid is necessary for normal hearing.

In two patients having abnormally patent tubes, as soon as these were opened a sensation of fulness, impairment of hearing, and diminution of the concavity of the drum-head were noticed. As soon as the tubes were closed all these symptoms disappeared.

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